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AN ENERGY DIET FOR MOBILE HOMES:

An Owner's Guide To Saving Money

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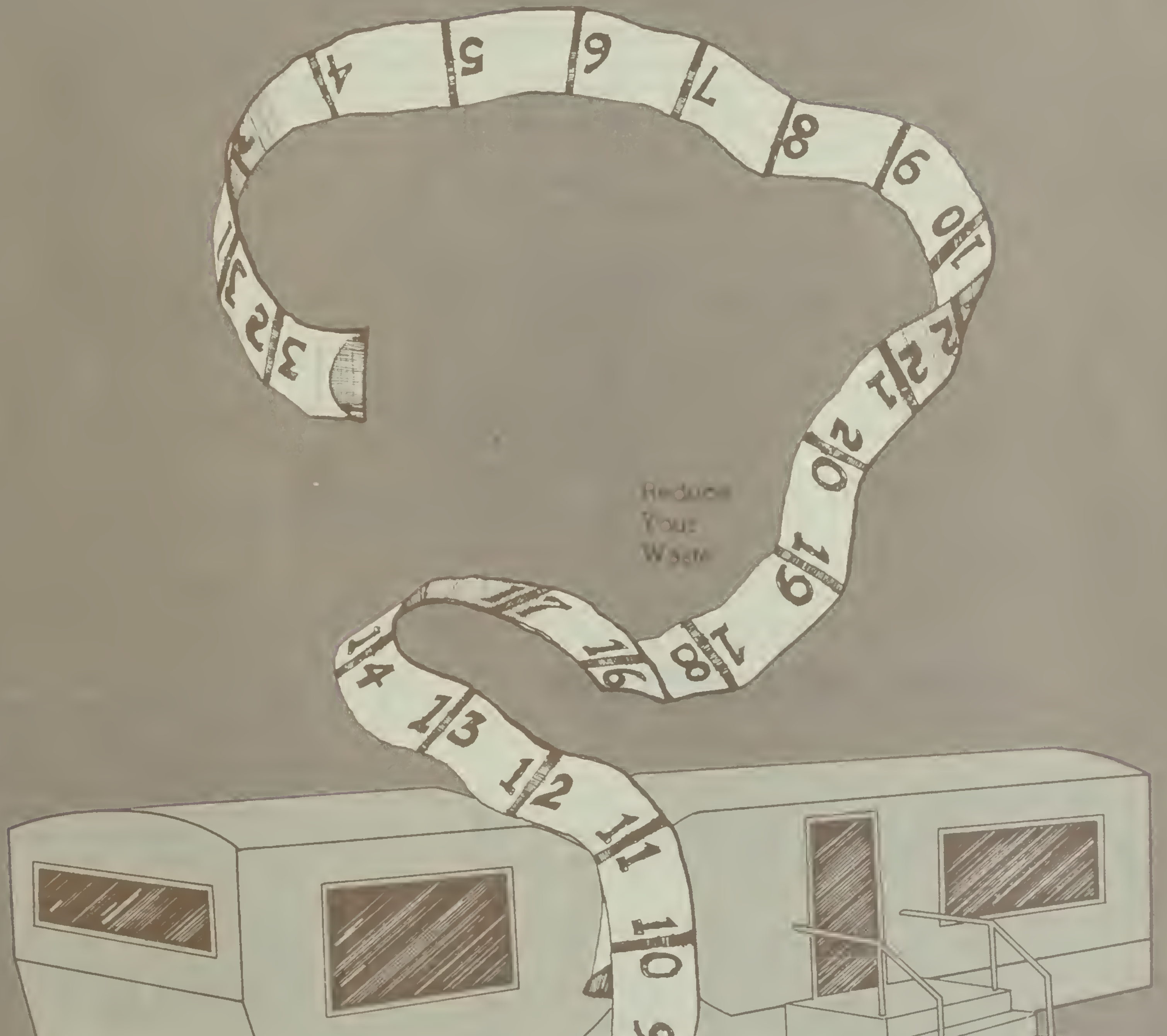

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AN ENERGY DIET FOR MOBILE HOMES: An Owner's Guide to Saving Money

Corrections and Recommendations - July 1982

The following corrections and additions have been made to the NCAT publication, AN ENERGY DIET FOR MOBILE HOMES, by the technical staff at NCAT. The supplemental material is listed by page and paragraph number.

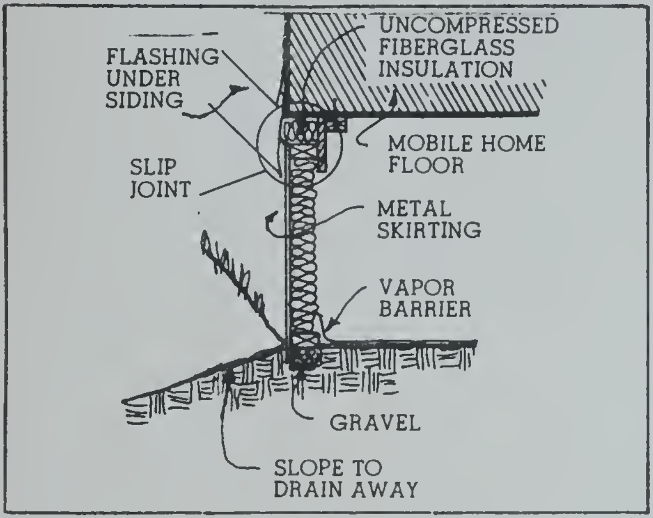
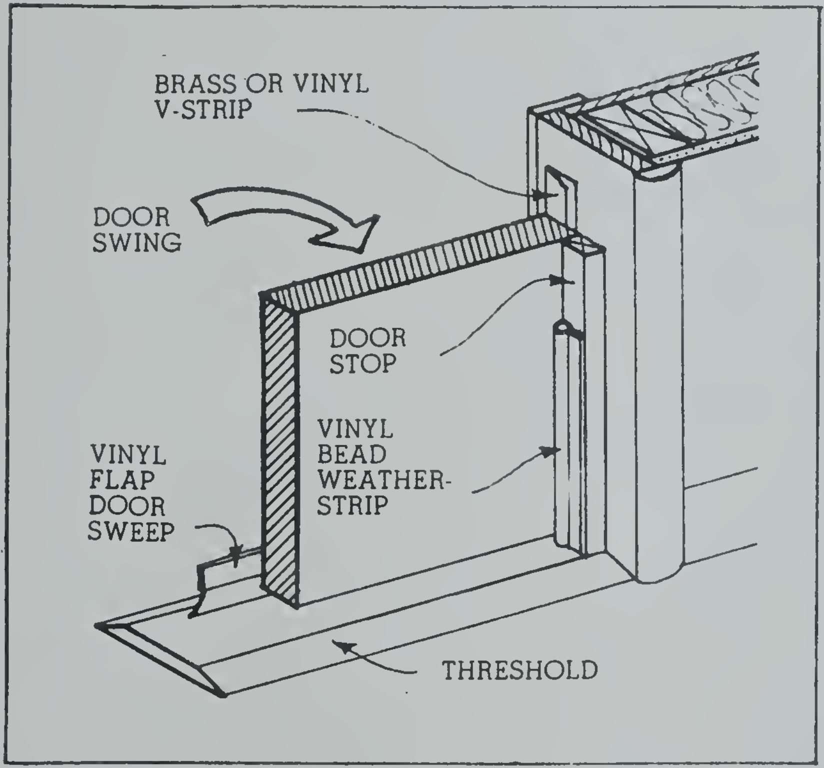


FIGURE 9

Skirting the Crawl Space - P. 9,

Figure 9

Use a slip-jointed flashing to cover the gap between the bottom of the mobile home and the top of the skirting framework. Make sure that the wood used for the part of the skirting framework that touches the ground has been treated for wood rot.



Replacing Doors - P. 10,

Figure 11

This figure was reversed in the original drawing. Weatherstripping can be used to stop air infiltration.

Winterizing the Bathroom Fan Vent - P. 15,

Paragraph 2

Cover the fan switch with duct tape or adhesive tape and place a sign above it that says DO NOT TOUCH, in order to prevent someone from turning the fan on while the opening is sealed with insulation.

The Walls - P. 14,

Paragraph 1

When trying to stop air infiltration around dryer vents and behind electrical outlets you might consider using a non-flammable material like fiberglass.

AN ENERGY DIET FOR MOBILE HOMES:

An Owner's Guide To Saving Money

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INTRODUCTION

Cutting Energy Costs

Mobile homes have always been the most affordable type of housing for millions of Americans. But a mobile home can quickly become unaffordable when you have to pay the monthly utility bill. By plugging air leaks and insulating your mobile home you can spend less to heat and cool, and be more comfortable.

The energy conservation tips outlined in this booklet are low-cost steps that any mobile homeowner or renter can complete. The investment of a modest amount of time and money should bring almost immediate savings on utility bills. The work you do on your own home may even qualify for federal and state tax credits and deductions — increasing the payback on your investment.

Using This Booklet

The cost of different home energy uses varies with local climate. If you live in south Texas your highest energy costs are probably related to heating water and cooling your home. In most of North America, however, space heating is the highest energy expense.

If you want to get the most out of the energy-saving ideas in this booklet, you should identify your largest energy losses and try to resolve them first. Maybe your furnace has never been cleaned and the furnace filter is two years old. In this case, your first task will be to clean the furnace and replace the filter.

Some tasks need to precede others in order to obtain maximum energy savings. If foundation problems are causing your mobile home to move slightly, you should stabilize the foundation before caulking and weatherstripping. Otherwise, continued movement will reopen the gap that you are working to close.

Since mobile homes vary somewhat with age and manufacturer, we cannot describe the exact location of all your problems, but we can give you the basics you'll need to locate and plug those energy leaks. You may have to do some investigating to locate the furnace filter and incoming pipes and wires.

Don't be discouraged if you have problems with any of the tasks. Reread the instructions carefully, try each step more than once, and if you get stuck call a friend or see a professional for advice. Mobile home dealers and repair services often have expertise in weatherization and are willing to offer their products, services and advice. If you contact a professional to do a more difficult task — like leveling your mobile home — shop around before hiring someone.

We begin by showing you how energy is wasted in a mobile home that hasn't been weatherized.

HOW YOUR MOBILE HOME WASTES ENERGY

Most mobile homes are heated by forced air furnaces or electric baseboard heaters. These heating devices go on and off in order to replace the heat that is lost. Heat always travels from hotter to colder areas, during both the winter and summer. Heat escapes your home in four different ways: (1) Conduction, (2) Convection, (3) Radiation, and (4) Infiltration.

Conduction

Heat passes through solid objects by conduction. A lot of heat is lost through doors and windows because glass and metal are both good conductors of heat. Insulation installed in walls, ceilings and floors helps to reduce heat flow by conduction because insulation conducts heat very slowly.

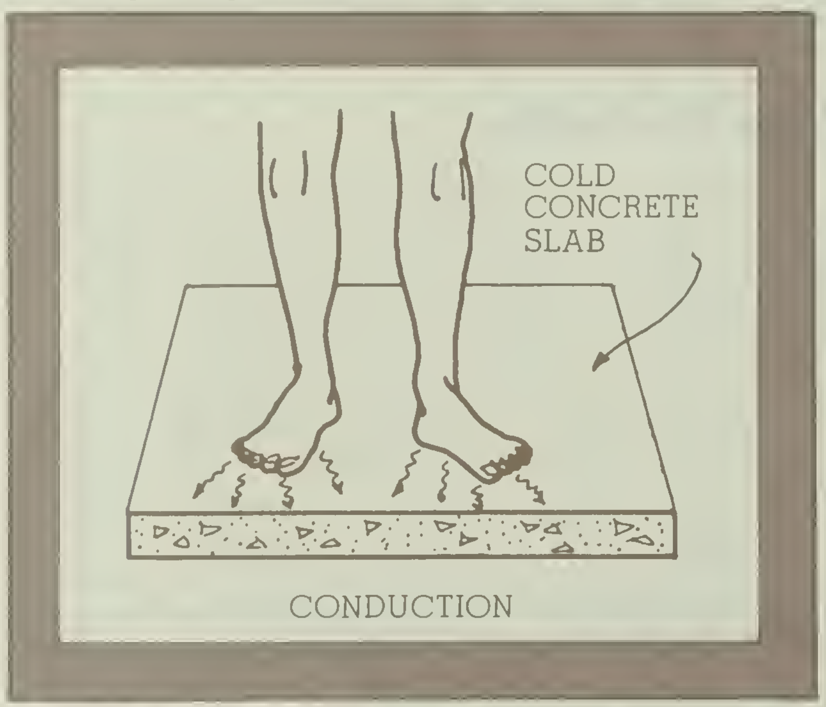


FIGURE 1
When you stand on a concrete floor in bare feet the surface feels cold because heat is flowing out of your feet into the concrete.

Convection

Heat moves between a surface and a moving fluid — either liquid or air, when one area is warmer than the other — always from the warmer to the colder. The greater the temperature difference between the two areas, the more heat is transferred.

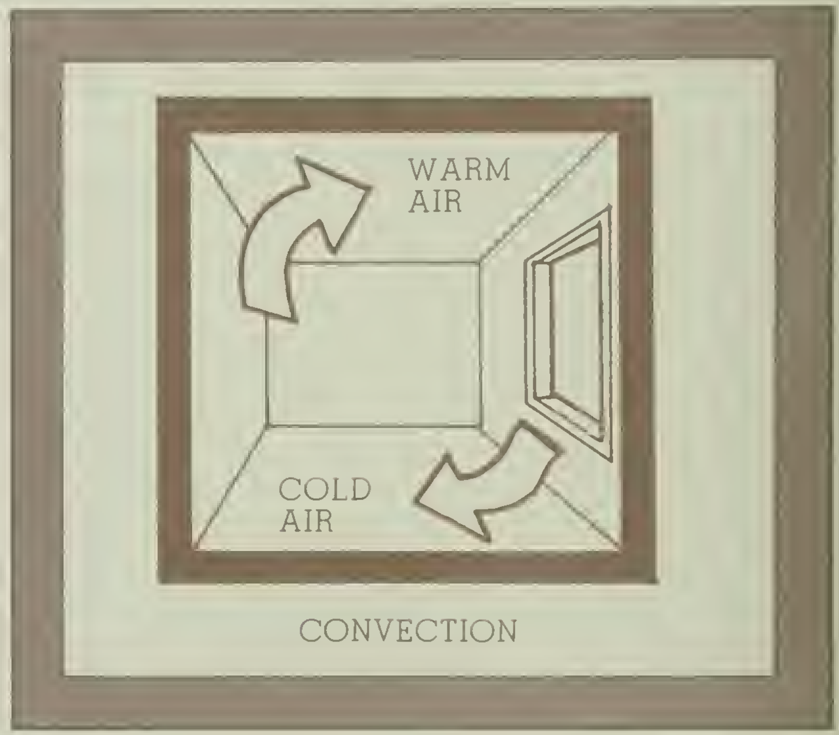


FIGURE 2
Warmer air moves upward toward the ceiling and cooler air falls toward the floor.

Radiation

When heat moves through a solid object to its surface, the heat leaves the surface if the heat can find a cooler place to go.

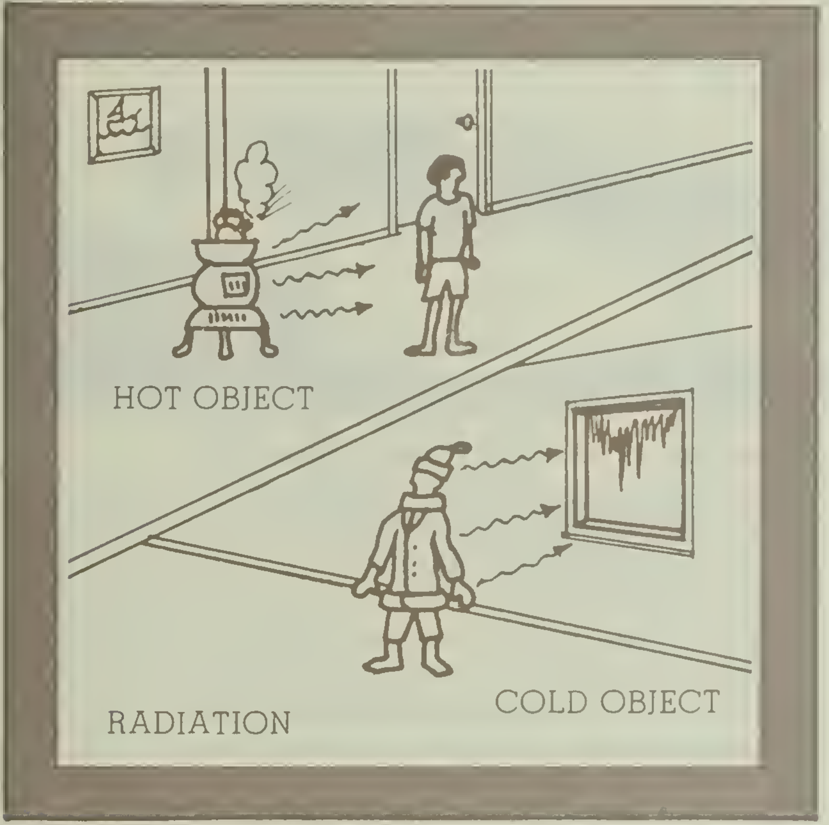


FIGURE 3
The heat stored in your clothing and skin radiates to the cold glass.

Infiltration

Cold air infiltrates your home through holes and cracks around windows, doors, and through holes in your floor, walls and ceiling. This cold outside air mixes with inside air that you are paying money to heat. Heated air finds its way out through other holes.

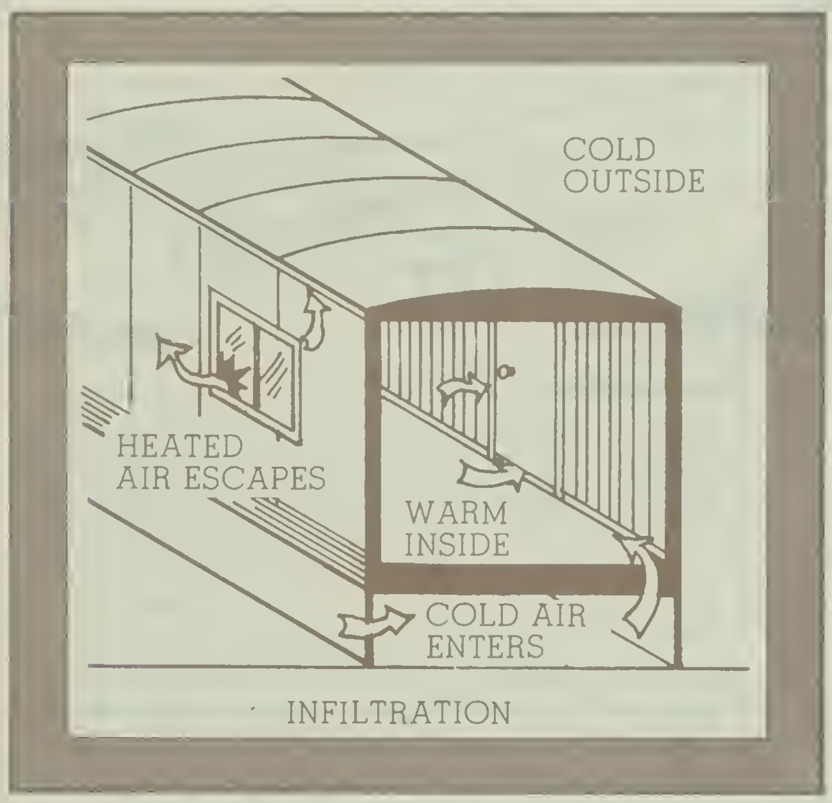
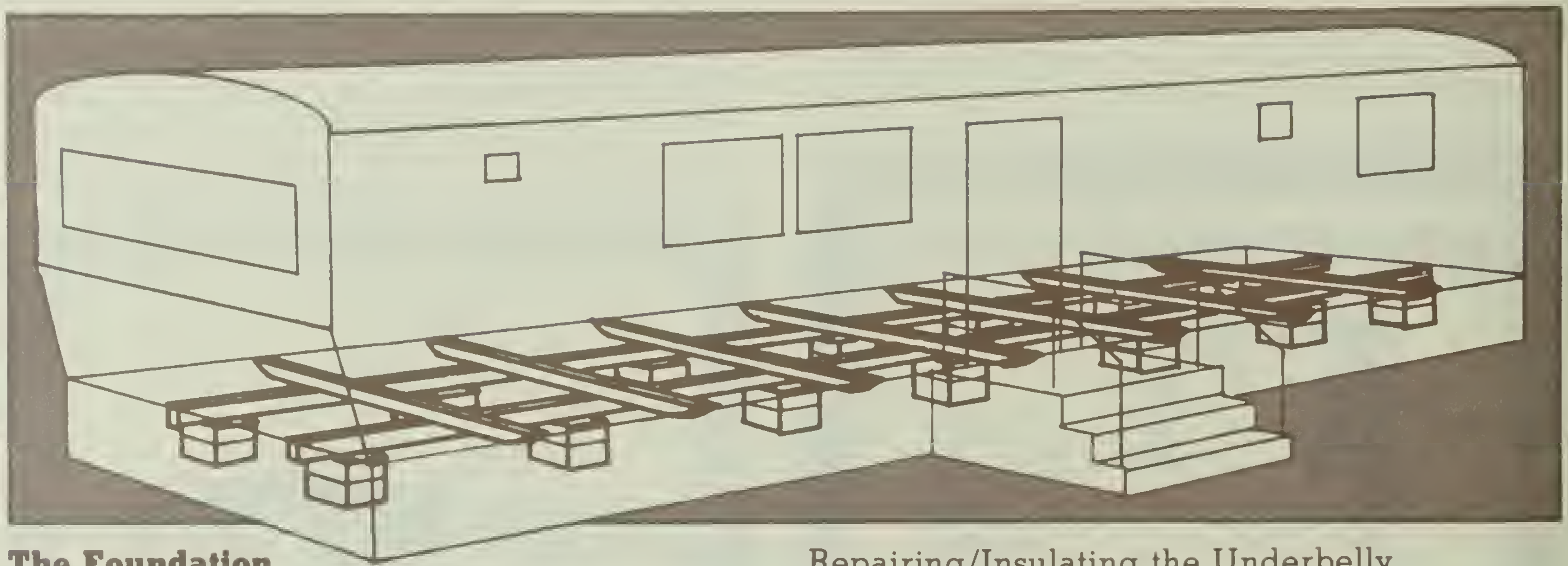


FIGURE 4
Heat escapes and cold air enters through cracks around the windows and doors and through uninsulated floors and walls.

WHAT YOU CAN DO:

PUTTING YOUR MOBILE HOME ON AN ENERGY DIET



The Foundation

Your mobile home foundation may seem like a strange place to start looking for energy leaks; however, when your home is not sitting on a solid foundation, frost heaving and vibration can cause cracks around doors and windows to open wider, letting out valuable heat. How do you know if your foundation needs to be secured or re-leveled? 1) Windows and doors that are difficult to open and close indicate that your window frames and door frames may be out-of-square because the foundation has moved or is improperly blocked and leveled. 2) Check the ground underneath your home for moisture, because moisture is an indication that the ground may be freezing and thawing, causing the foundation to move.

Stabilizing and Leveling the Foundation

Look underneath your home at the supporting piers or foundation walls. Look for any cracks or spaces between the foundation and the main beams it supports. There should be a foundation pier every eight feet or less, if not, additional piers should be added for support.

If the ground underneath your home is wet, you might want to try draining off the moisture by digging a sloping ditch and laying perforated drain tile in the ditch or by just filling the ditch with gravel. If you install the drain tile cover it with gravel to complete the job. NOTE: *Before digging a ditch contact a local landscaper to find out ground water conditions in your area and to get advice on the best methods for correcting drainage problems.*

Because foundation work is both difficult and dangerous, we recommend that you consider hiring a professional to stabilize and/or level your mobile home foundation. Get several estimates before hiring someone.

Repairing/Insulating the Underbelly

The underbelly of a mobile home is a common source of heat loss in cold climates and should be carefully inspected and repaired. After you're sure that the foundation is level and secure, enter the crawl space with a flashlight and inspect the underbelly for loose or damaged belly boards. The belly board supports the insulation if there is any and protects the floor from cold air entering the crawl space. Since the belly boards are thin fiberboard sheets they often tear, puncture or come loose at the seams. Newer homes have a tough fabric air infiltration barrier (AIB) that takes the place of the belly board. You can sometimes repair the torn fabric with a canvas or leather patch.

If the belly board is waterlogged, sagging or badly damaged, you should consider removing it. With the belly board off you can check for wet insulation, leaky or uninsulated heating ducts, and uninsulated water pipes. If the insulation is wet, remove some of the skirting and let the insulation dry for several days. If the insulation can't be salvaged or if there is no insulation you should insulate the floor.

There are several ways to reinsulate the floor of a mobile home. One method is to install fiberglass insulation between the floor joists with staples or wire insulation supports. Another method involves using extruded styrofoam that is then covered with exterior plywood. Loose-fill insulation can be blown in with an insulation blower or pushed in between the new belly board and the floor of the mobile home with a broom. **(Figure 5)** A fabric, air infiltration barrier can also be used to support loose fill insulation. You can stretch the AIB around the main beams, pipes and foundation piers. This installation procedure is only appropriate when you do not plan to move the mobile home. You can improve existing insulation in your floor by fastening ¾ inch extruded styrofoam to the floor joists with 1½ inch roofing nails.

If you remove the belly board to reinsulate, you should insulate the heating ducts with fiberglass insulation and seal the joints in the ducts with silicon caulking. All hot water pipes in the floor should also be insulated.

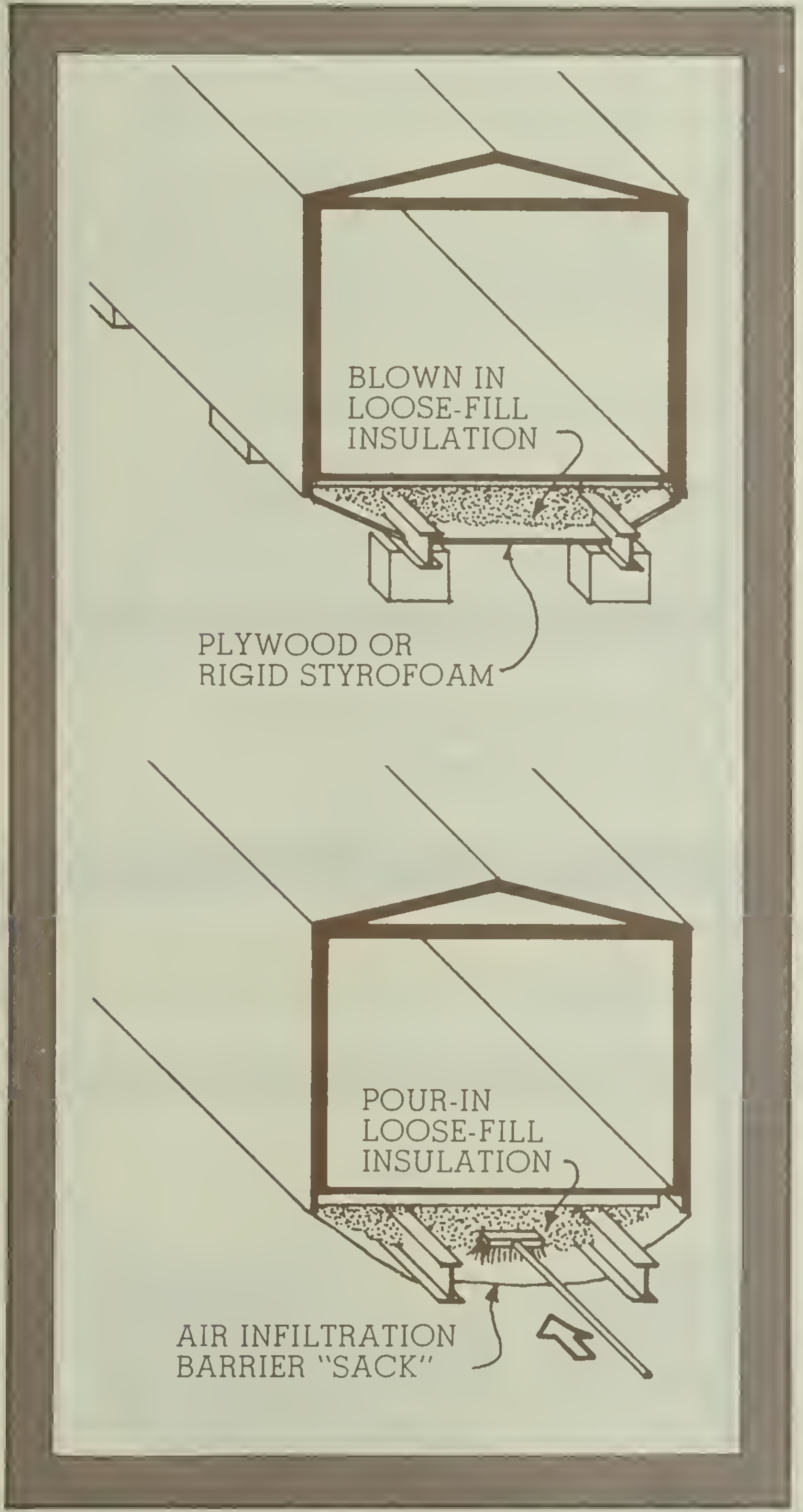

BLOWN IN LOOSE-FILL INSULATION
PLYWOOD OR RIGID STYROFOAM
POUR-IN LOOSE-FILL INSULATION
AIR INFILTRATION BARRIER "SACK"

FIGURE 5
A broom can be used to push loose-fill insulation in between the air infiltration barrier and the mobile home floor.

Siting Your Mobile Home

Proper siting of your mobile home can help you save energy. In selecting a site, stay away from low-lying areas near rivers and streams, particularly if the ground water is close to the surface. Water in the ground increases the possiblity of flooding and foundation movement due to settling and frost heaving. Find a site where the drainage is good and the ground stays relatively dry year-round.

LIVING WITH THE WIND

Find out the direction of the prevailing winds, summer and winter, and set up your home to take advantage of cooling summer breezes and to take refuge from cold winter winds. However, in siting your mobile home in a high wind area your first consideration ought to be safety rather than summer ventilation. A mobile home sitting with its long side to the prevailing wind can be very dangerous in the event of high winds. Trees, hills and fences help to break heat-robbing winter winds.

ACCESS TO THE SUN

In order to receive the maximum benefits of the sun during the winter and to minimize overheating problems in the summer, set your home so that the long sides are facing south and north, and the ends of your trailer face east and west. With the proper orientation the windows on the south will collect additional heat during the winter and the smaller window area on the west should cut down on the amount of heat collected during the long summer afternoons. Set your mobile home down with the kitchen facing east so that you get early morning light there. By doing this the kitchen will also be cooler in the evening for cooking dinner.

SHADING

Shading is a very important consideration especially in warm climates. The most common forms of shading are trees, trellises and overhangs. However, you can buy tinted plastic films that adhere to glass and screen out sunlight. Solar shade screening is also available that attaches to the outside of your most troublesome windows.

If your mobile home is presently sited improperly, you might consider rotating it to help you gain the benefits of a good orientation. If you live in a mobile home court, this may be impossible and even if it is possible, you still have to weigh the expense of moving your mobile home against potential energy savings.

If the underbelly is sound, it probably isn't worth removing the belly boards to inspect pipes and ducts. In this case you can inspect the seams between the boards for those that are damaged or loose. Repair the loose seams by nailing wood batten strips over the seams. Caulk all the seams and cover damaged areas too large for caulking with building paper or plastic film. **(Figure 6)**

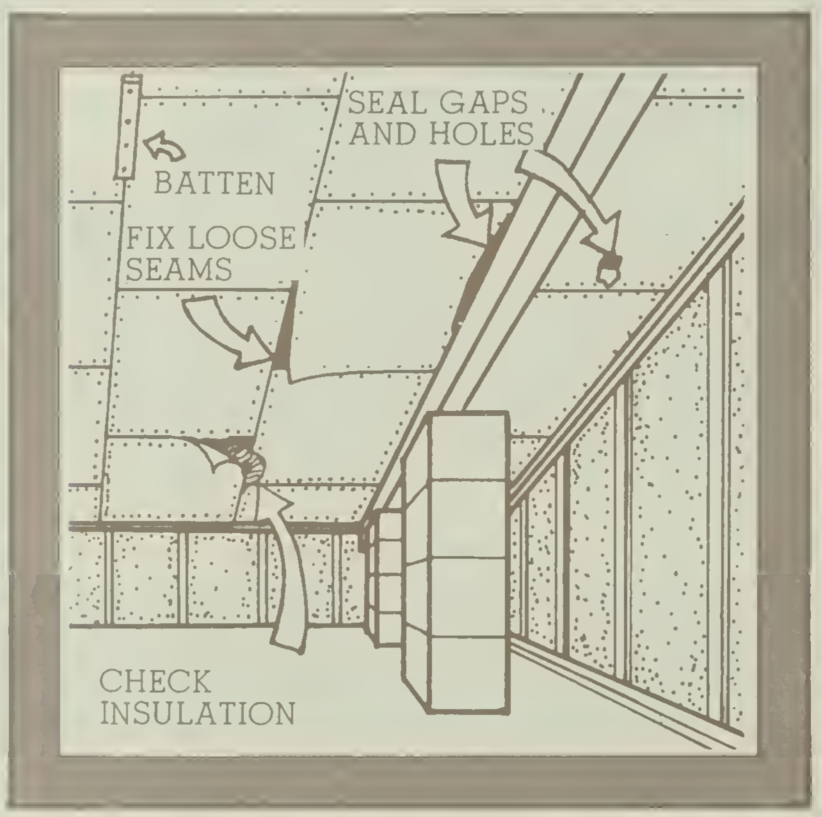


FIGURE 6
Sealing up the underbelly helps stop energy-wasting infiltration.

Any water pipe that penetrates the belly board or AIB should be wrapped with thermostatically controlled heat tape and insulated if you live in a cold climate. Heat tape can be easily damaged during installation if you're not careful. Don't wrap the heat tape too tightly and don't cross the tape back over itself as this could cause a short. Wrap fiberglass or foam pipe insulation loosely over the heat tape and fasten it without putting too much pressure on the heat tape. (Figure 7)

SECURING THE MOBILE HOME FOUNDATION

Site-built houses are usually attached to the foundation by inserting bolts into the concrete and then bolting the wooden sill plate directly to the top of the foundation wall. Mobile homes are often set on foundation piers without being tied down tightly to a foundation or to the ground. Mobile home tie-downs keep the wind from lifting the mobile home off its foundation and prevent vibration that can open cracks and loosen fasteners. The tie-down is like a miniature auger that you screw into the ground. Most mobile homes have straps connected to the frame that are used to fasten the home to the tie-down. If your mobile home doesn't have straps you can use steel banding or aircraft cable. **(Figure 8) CAUTION: A mobile home that is not tied-down is dangerous if you live in an area where high winds are possible because high winds could overturn it.**

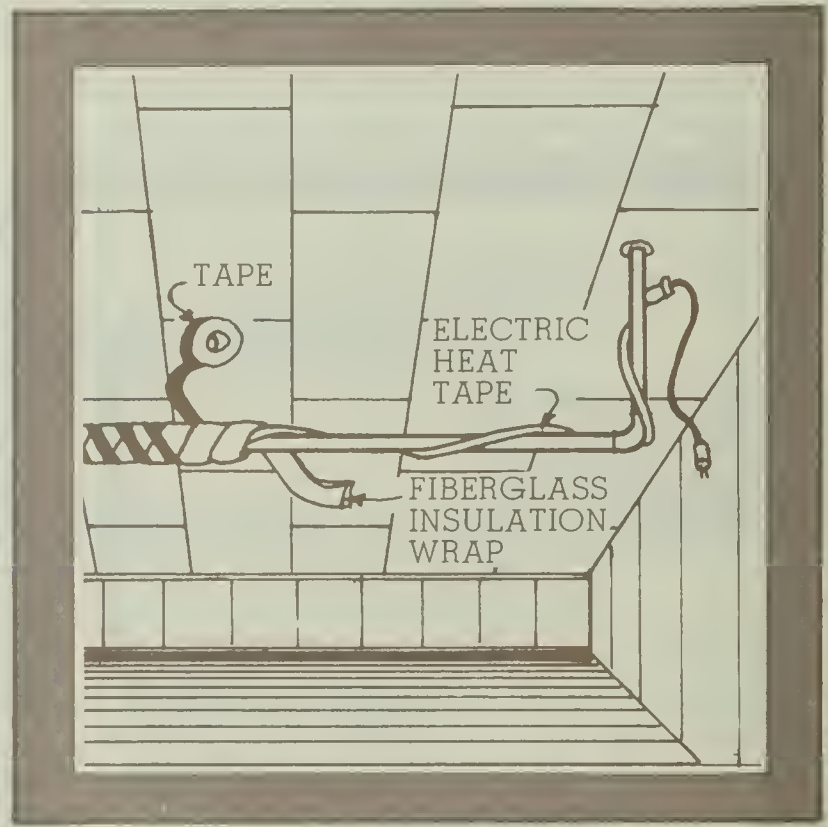


FIGURE 7
Wrapping the pipes underneath with heat tape and insulation wrap will help to prevent pipes from freezing.

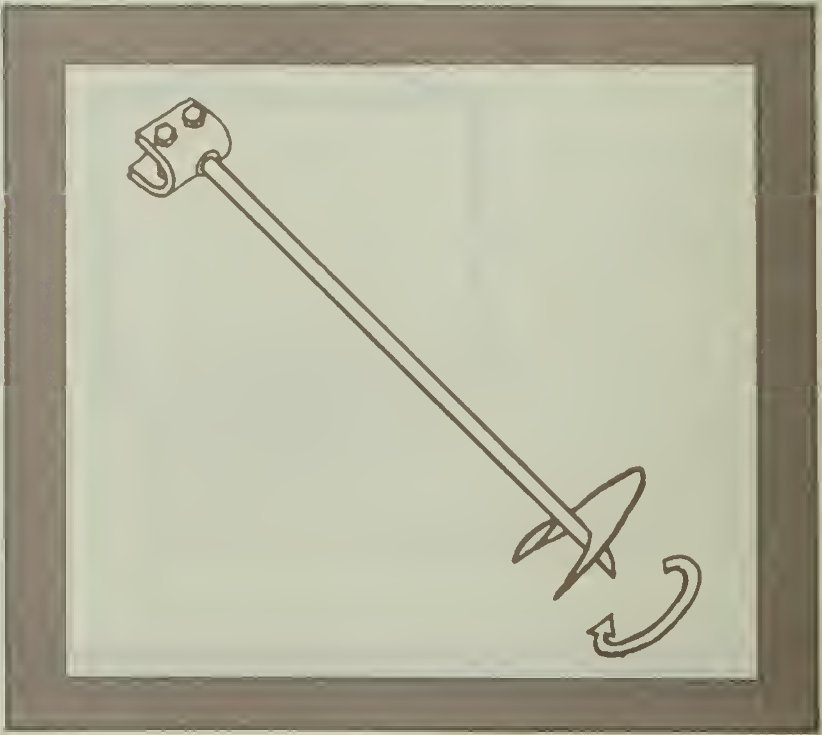


FIGURE 8
Tie-downs help keep your mobile home attached to its foundation during periods of high winds.

SKIRTING THE CRAWL SPACE

Enclosing the crawl space with skirting makes a mobile home warmer and more secure by breaking the wind and stabilizing the temperature in the crawl space. Skirting reduces the danger of frozen pipes and makes the mobile home safer for children that play around the perimeter of the home. Skirting installation varies with climate.

If you live in a damp climate you need to beware of the problems caused by moisture. Water in the soil can deteriorate skirting materials and freezing ground can heave the skirting and move the mobile home. A floating framework or a gravel bed for the skirting will prevent heaving problems. **(Figure 9)**

If you live in a drier climate you have a greater selection of skirting methods and materials.

The most common materials for skirting are wood, fiberboard siding, or interlocking aluminum or plastic panels. The wood and fiberboard products should be avoided in wet climates where they might rot or come apart when they absorb moisture. Aluminum panels dent easily so they may take a beating where children and animals play. Plastic panels are more durable but also more expensive. Skirting materials are generally available through lumber yards and mobile home suppliers.

Before assembling the wood or metal skirting framework you should cover the ground underneath your mobile home with a 6 mil polyethylene vapor barrier. This will prevent moisture in the ground from dampening the underside of your mobile home.

Smooth and level the ground around the perimeter of the mobile home before you install the skirting framework. The horizontal framing pieces can be pinned to the ground at the bottom and nailed to a solid wood floor joist at the top. Remember to allow the framework to float if frost heaving occurs in your area. **(Figure 10)**

In cold climates you can save energy and keep your floors warmer by insulating the skirting. A framework with vertical studs spaced 16 or 24 inches apart will make insulating with fiberglass easy. The lightweight manufactured skirting may require you to use a more expensive but durable rigid foam insulation. You'll have to use your imagination to devise a way to glue, wire or wedge the rigid foam insulation in place behind the skirting.

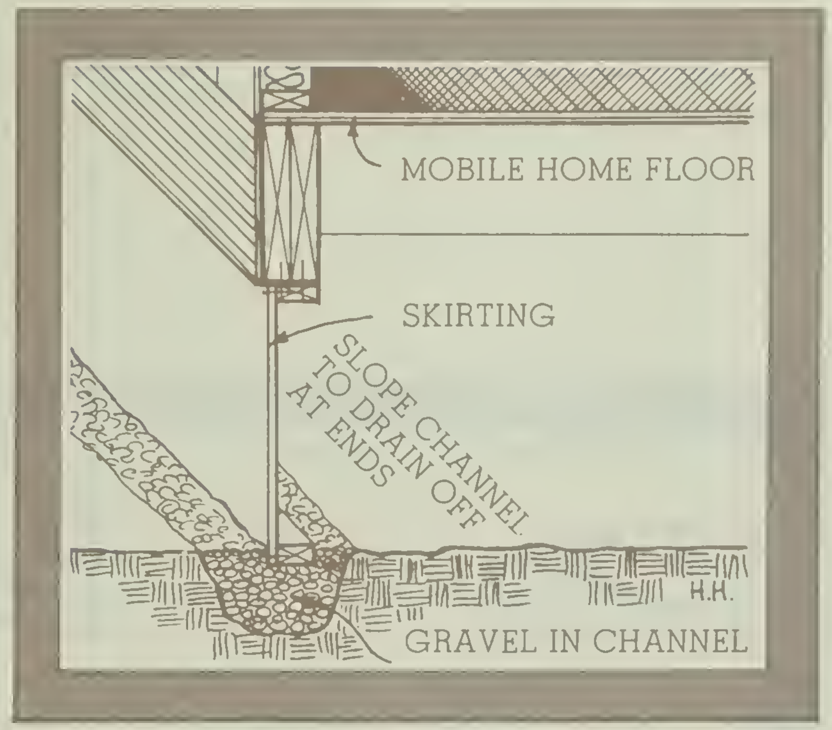


FIGURE 9
An adequately drained site is particularly important when attaching skirting to your mobile home.

Be sure to frame a small doorway in the skirting framework to provide easy access to the crawl space for repairs. Fasten the door to this framework so it can be easily removed.

VENTING THE CRAWL SPACE

The crawl space needs to be vented in order to keep the underside of your mobile home free from moisture year-round. Federal housing standards recommend a one square foot vent in the skirting on both ends of your mobile home for each 1,500 square feet of crawl space. If you decided not to install a vapor barrier, you need to cut vents on all four sides of your mobile home measuring one square foot for each 150 square feet of crawl space. Cover the vent openings with a louvered vent cover and screen to keep the weather and insects out.

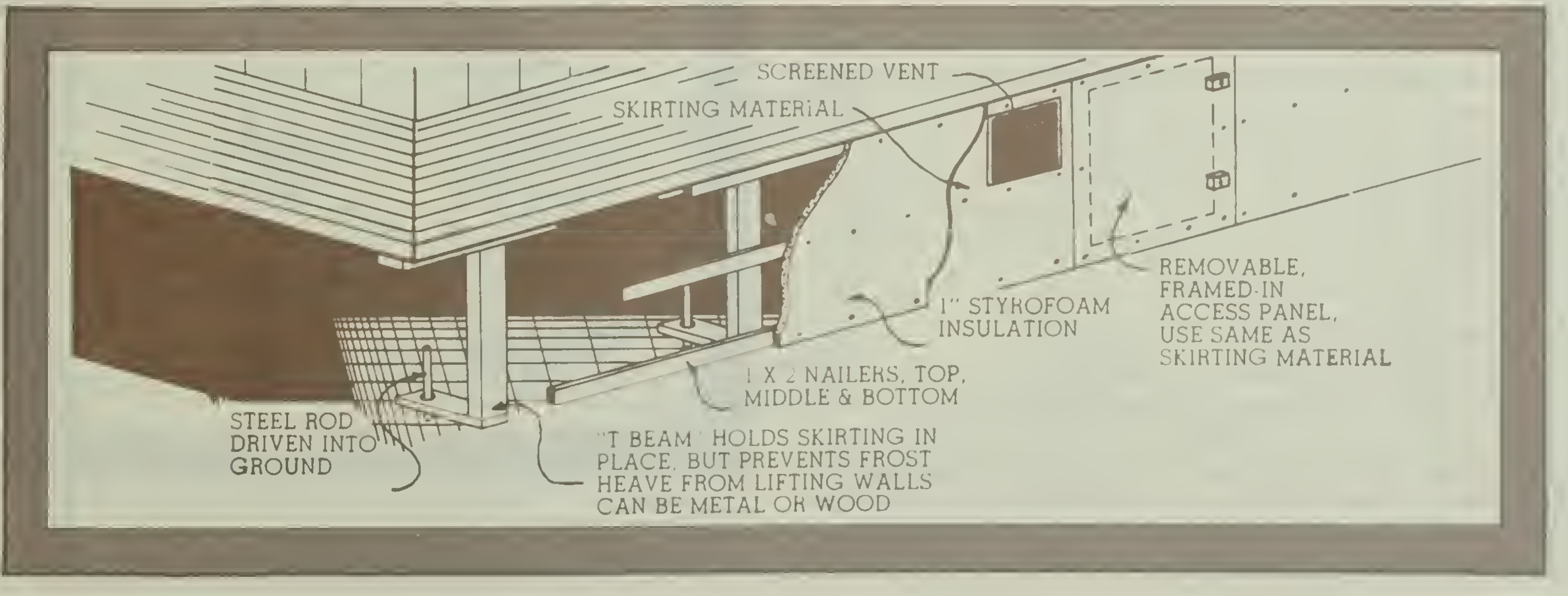

SCREENED VENT
SKIRTING MATERIAL
REMOVABLE, FRAMED-IN ACCESS PANEL, USE SAME AS SKIRTING MATERIAL
1" STYROFOAM INSULATION
1 X 2 NAILERS, TOP, MIDDLE & BOTTOM
STEEL ROD DRIVEN INTO GROUND
"T BEAM" HOLDS SKIRTING IN PLACE, BUT PREVENTS FROST HEAVE FROM LIFTING WALLS CAN BE METAL OR WOOD

FIGURE 10
Building a flexible skirting framework helps to overcome problems caused by the ground heaving due to frost.

Doors and Windows

Drafts around doors and windows lead to high energy bills and occupant discomfort. If you plug those air leaks your mobile home will be much cheaper to heat and cool and more comfortable to live in.

MAKING THEM WORK

Check your exterior doors and windows to see that they operate smoothly and close tightly. Tighten loose screws in the hinges and handles on your doors and adjust the door stop to fit snugly against the door when it is closed. Notice the gap at the door bottom. You can often adjust the door sweep to close the gap between the sweep and the threshold. If the sweep or the threshold are worn and torn, it may save you money to replace them. **(Figure 11)**

Look at the weatherstripping around the door. If it is loose or damaged replace it with a good quality weatherstrip. Rigid weatherstrip with a vinyl rubber bulb or flap is the best type for the door stops. A rigid brass V-strip works best for door jambs. Flexible foam rubber tape or felt tape are cheaper but they don't work as well or last as long. Self-adhesive V-strip weatherstripping is available at many hardware stores or building suppliers and works fairly well. If you still have problems getting your doors and windows to operate properly and close tightly consult with a local carpenter or mobile home repair service.

REPLACING DOORS

Do you have problems with frost forming on the inside of the hollow metal entrance door of your mobile home? If so you may want to replace your old door with a new insulated door. A new foam-core door will eliminate the problem of frost forming, save energy and make the house more comfortable, but remember that a new door will not be cheap.

The trim around the inside doors often provides a convenient path for cold air to enter your home. Mark the inside wall along the door trim and carefully remove the three trim pieces. Stuff the crack along the door frame with foam or fiberglass insulation and caulk over it. Nail the trim back to the wall with 1½" paneling nails every six inches. You can buy paneling nails in a variety of colors to match the color of your trim. **(Figure 12)** *NOTE: There are several types of caulk available at hardware stores and building suppliers that vary in*

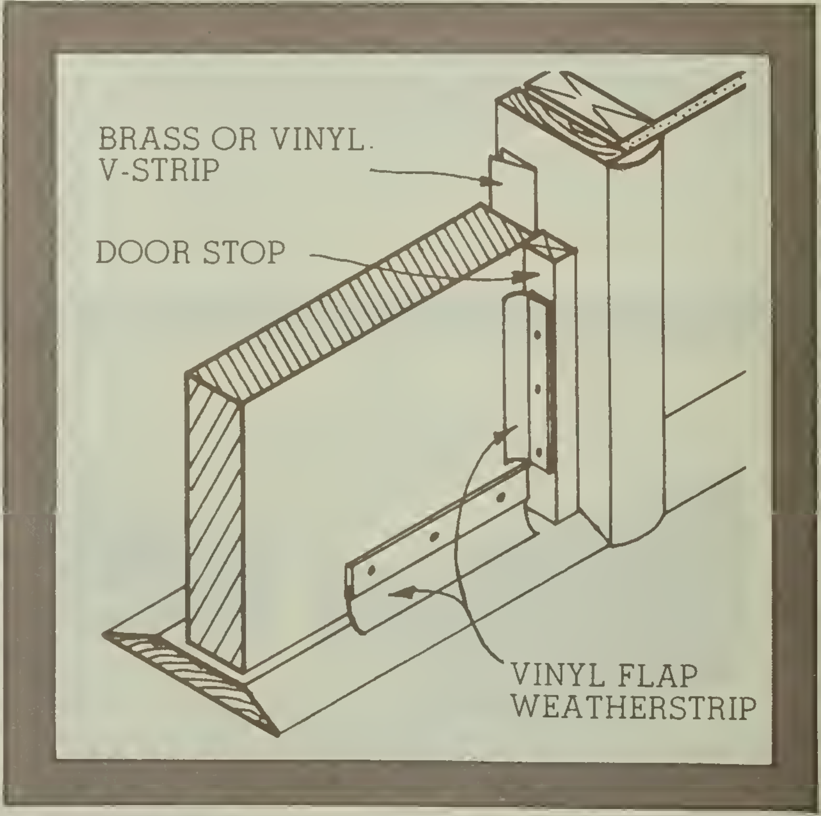


FIGURE 11
Weatherstrip can be used to stop air infilatration.

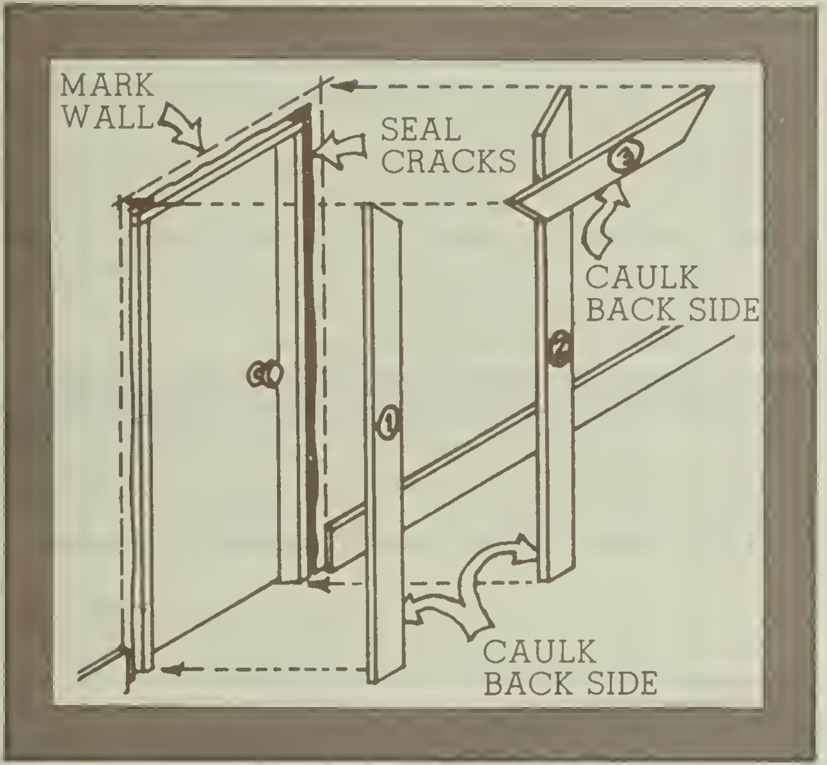


FIGURE 12
By removing the trim around the door you can more effectively seal any cracks with caulk.

price and quality. Acrylic latex caulk is available in a variety of colors for interior use. Silicon, silicon latex and the rubber-based caulk are more expensive and durable and are recommended for outside use.

In cold climates the addition of a storm door or a sheltered entryway will help cut heating costs, but the expense may outweigh anticipated energy savings.

REPLACING WINDOWS

Broken windows are heat sieves. Replacing broken glass is not as difficult as it might seem. The aluminum window sash is held together with screws or corner clips, making it easy to take apart. In measuring the window for glass replacement make sure to allow for the rubber gasket surrounding the glass and the groove that the windowpane fits into. **(Figure 13)** Double check your measurement before heading off to the glass supply store. A glass supply store can cut the glass to size for you and fit your frame with new glass if you don't want to do it.

Clear rigid plastic sheeting or tough plastic film can replace glass in windows temporarily or where glass is likely to break.

The clear rigid plastic comes in different thicknesses and will fit most aluminum window frames. The plastic film is fastened to the frame with a high quality weatherproof tape. *NOTE: Make sure to allow for seasonal expansion and contraction when cutting the clear rigid plastic.*

Jalousie window — slatted horizontal windows — work well for summer ventilation, but allow heat to escape during the winter. Cover them with plastic during the winter or consider replacing them with a standard window if they leak badly.

CAULKING AROUND WINDOW FRAMES

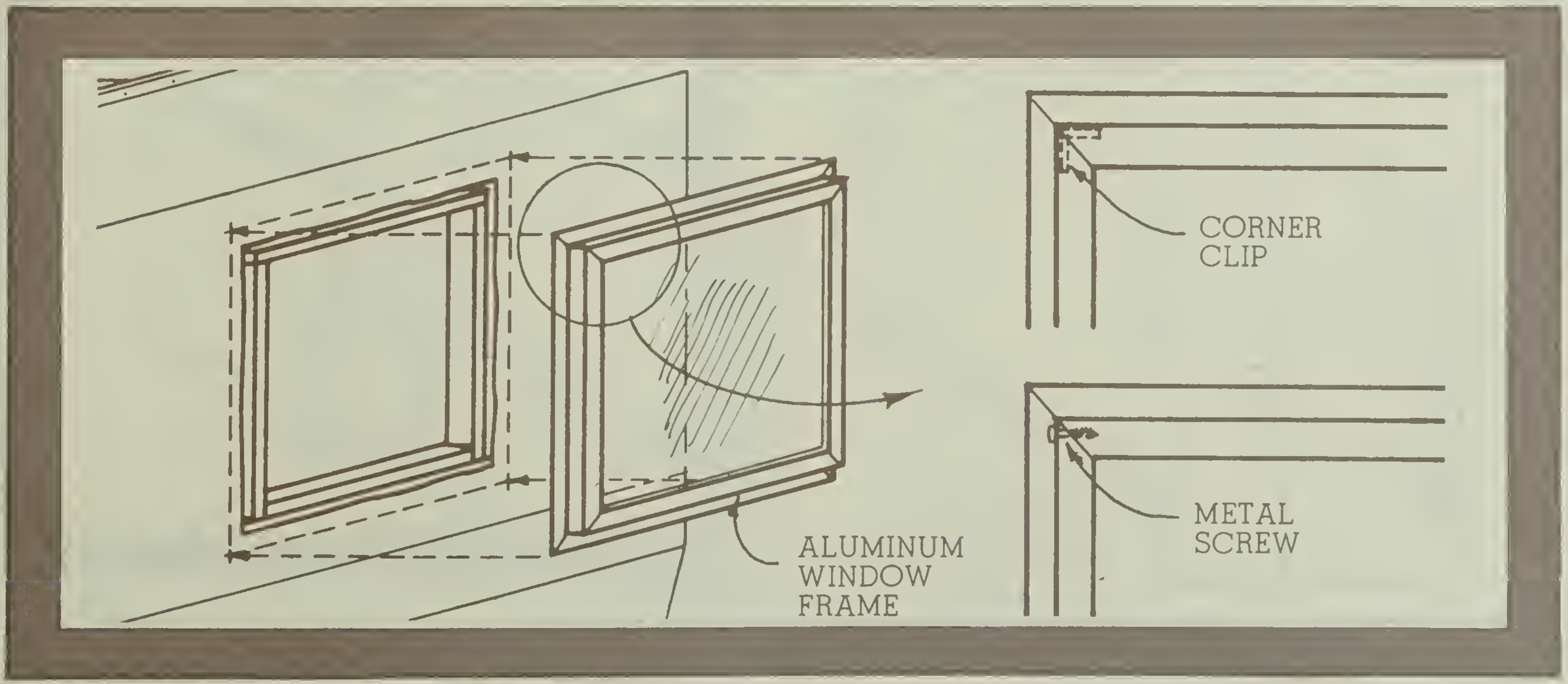
There may be gaps that you can't see underneath the interior window frame. Carefully remove the trim if there is trim and stuff and caulk the cracks. Replace the trim and fasten to the wall with 1½" paneling nails every six inches.

Also, caulk any cracks you see around the primary window frame. It's a good idea though, to leave a couple small gaps at the bottom of the primary window frame to allow water to escape.

INSTALLING STORM WINDOWS

All mobile homes, except those in mild climates, need storm windows. Interior storm windows are the rule for mobile homes because exterior storms are difficult to attach and seal. Interior storm windows usually have an

FIGURE 13
Replacing the glass in an aluminum window frame is relatively easy and will save you energy.



aluminum or plastic sash and mounting frame.

Storm windows reduce heat loss by creating an insulating airspace between the storm window and the primary window. If you live in a cold climate you may want to install a second storm window between the interior storm and the primary window. You will probably have to nail up some wooden framing pieces to the sides of the window opening to mount the second storm window.

The interior storm window sash is the framework that surrounds the pane of glass. Mobile home storm windows often come with their own mounting frame. The sash has a lip by which it clips into the mounting frame. The mounting frame is screwed to the wall on the perimeter of the window opening and the sash is mounted inside this frame. **(Figure 14)** The seams between the sash and the mounting frame and between the mounting frame and the wall usually leak air. You can improve the seal of these storm windows by weatherstripping the lip of the sash with a self-adhesive foam tape. **(Figure 14)** You can also caulk the backside of the mounting frame before you install it. If you have existing storm windows like the ones described above you can remove the frame and sash to caulk and weatherstrip them. Mobile home windows are the source of large energy losses, so take your time and do a thorough job.

INSTALLING DRAPERIES

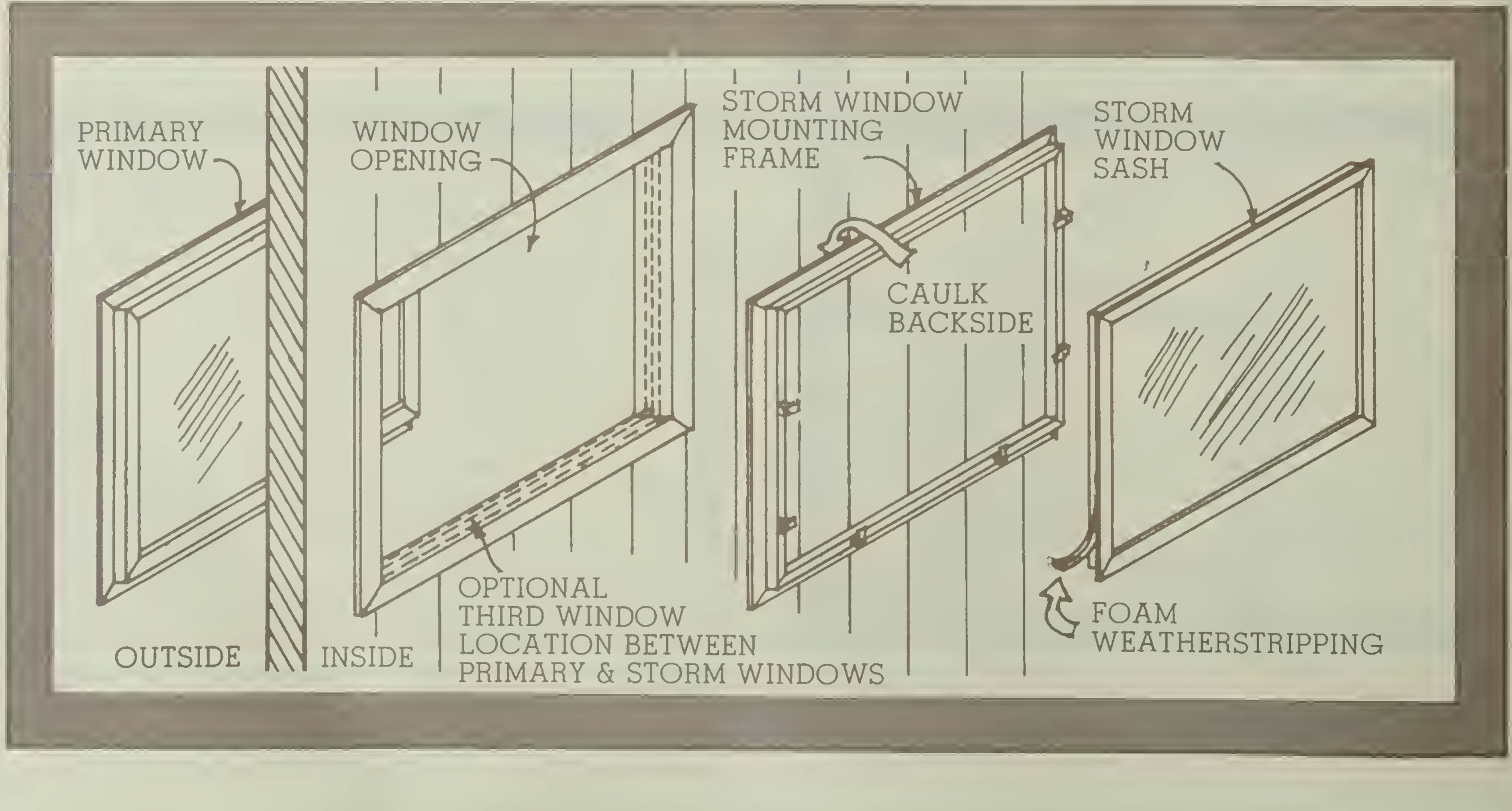
To further reduce heat loss and gain through your windows you might consider adding draperies or rolling window shades which are relatively inexpensive and normally available at most fabric shops. In order to work effectively, however, draperies need to cover the entire window, and they must be opened and closed at the proper times. In winter, draperies and shades are closed at night to reduce heat loss and opened during the day if they add significant light and heat to the home. In the summer, draperies and shades block out the blazing summer sun and are opened at night to let the heat escape. Insulated drapes, shades and shutters might be cost-effective in very cold climates. Refer to the Resource List for more information about movable insulation for your windows.

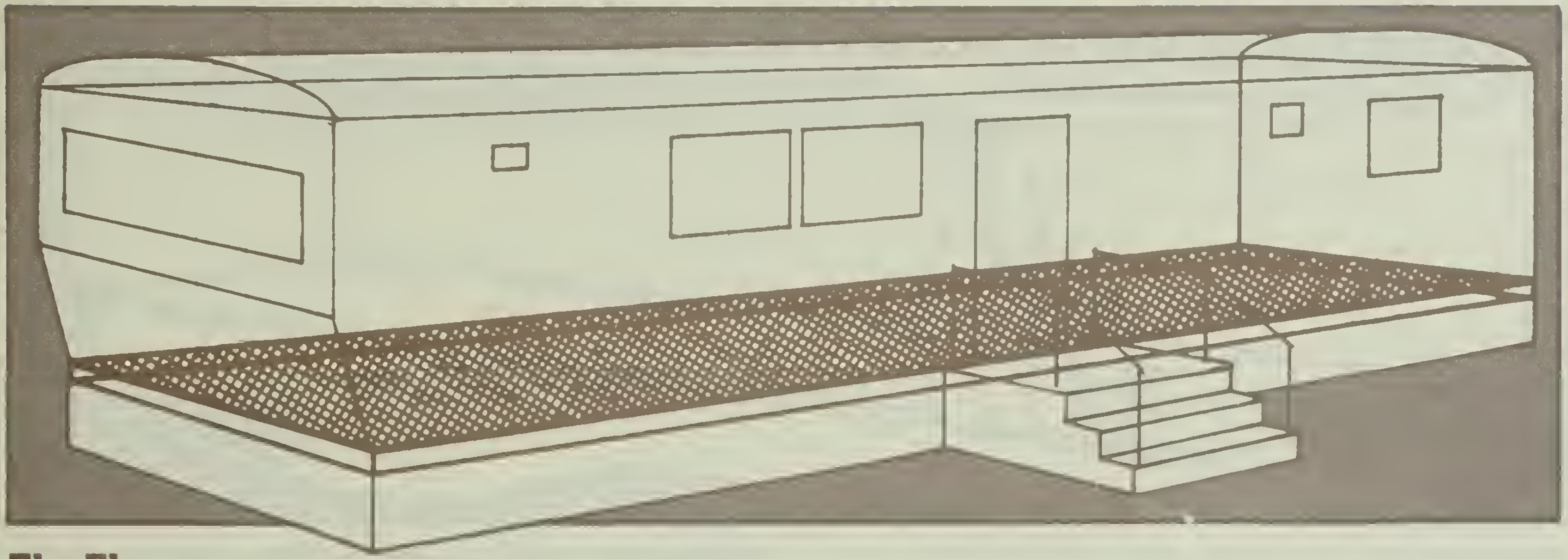
CAUTION: Because windows, especially in bedrooms, may be needed for a fire escape, make sure to devise a method for opening at least one window in case of an emergency. Every mobile home ought to be equipped with at least one smoke detector, since fires in mobile homes can be very dangerous.

If You Need To Know More About Weatherization

If you feel like learning more about general home weatherization techniques NCAT has published a six booklet series on that topic which is available for only $3. It includes how-to information on how to detect and fix air leaks, the various techniques for weatherstripping and caulking, how to insulate your hot water heater, and how to build a thermostat control timer in order to cut heating costs. All the booklets contain detailed illustrations and easy-to-follow directions for weatherizing all types of houses.

FIGURE 14
This exploded view of a mobile home window frame shows how to mount, caulk and weatherstrip storm windows.





The Floor

The floor in your mobile home is another source of energy leaks. Wherever pipes and wires enter your home through the floor, cold air enters around the holes — under the sinks and in the laundry area. Stuff each hole with foam rubber or oakum. Seal the smaller gaps with caulk. **(Figure 15)**

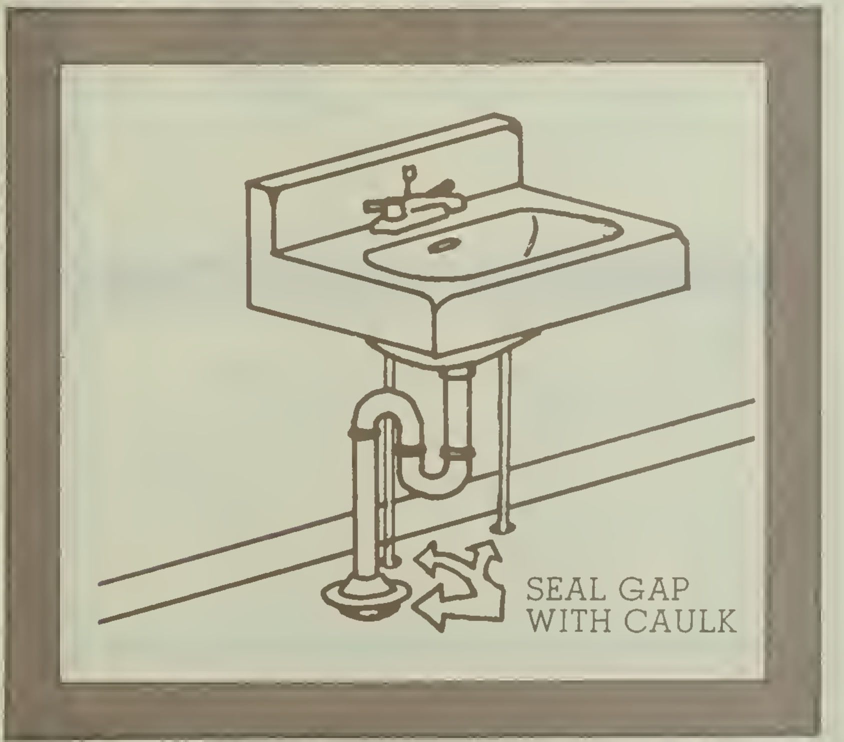
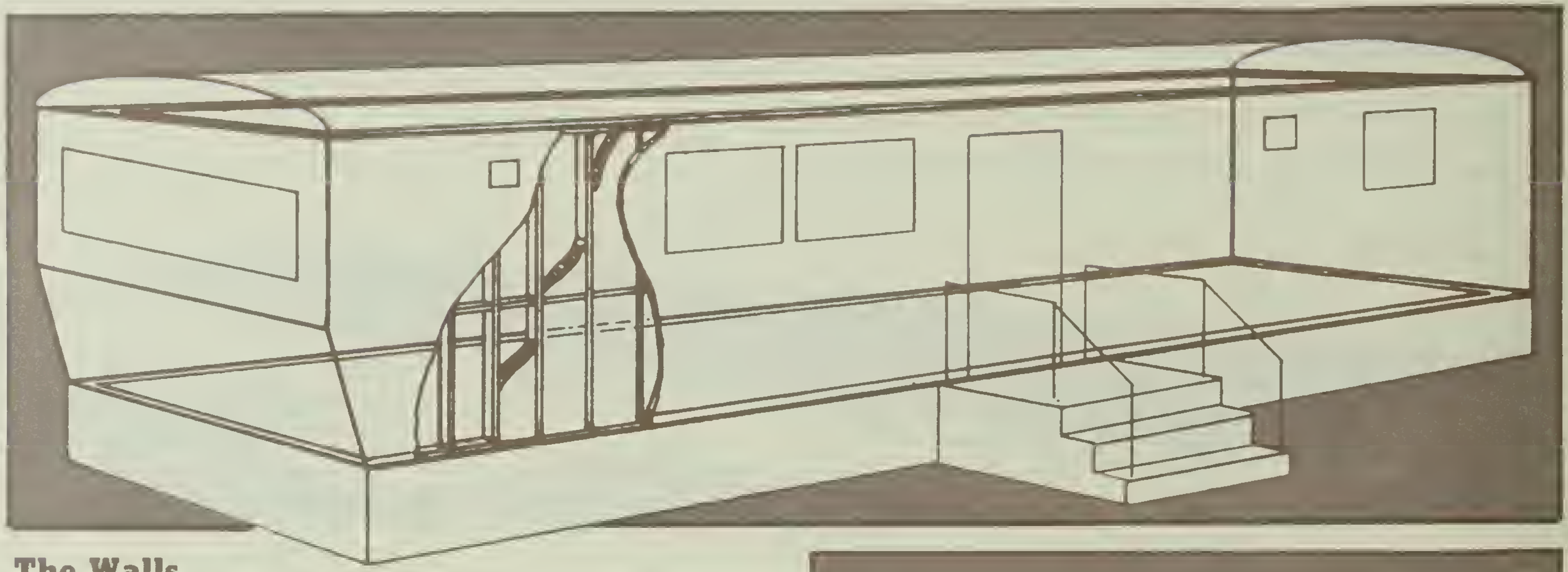


FIGURE 15
Caulk around all pipes or wires entering the floor of your mobile home.



The Walls

Cold air finds its way into your mobile home through holes in the walls around dryer vents, electrical outlets and seams in interior paneling. Check for air infiltration around the dryer vent. Fill any gaps with foam rubber and then caulk. Check the vent duct for leaks. Plug any leaks by wrapping the duct with duct tape.

Leaky electrical fixtures, outlets and switches can be sealed with foam rubber draft stoppers available at most hardware stores. The draft stopper fits behind the cover plates on wall switches and outlets. **(Figure 16)** Caulk around ceiling light fixtures to seal leaks there.

Seal joints in paneling, along baseboards and trim pieces with a clear caulking or colored acrylic latex caulking. In order to do a more thorough caulking job you can remove the baseboard, trim pieces and batten strips, and caulk the cracks behind them as you did with the door and window trim. Nail the trim pieces back to the wall with 1½" paneling nails.

After you plug the air leaks inside, go around the outside of your mobile home with a screwdriver or nutdriver and tighten all of the exterior screws. If a hole is stripped out, replace the screw with a larger one.

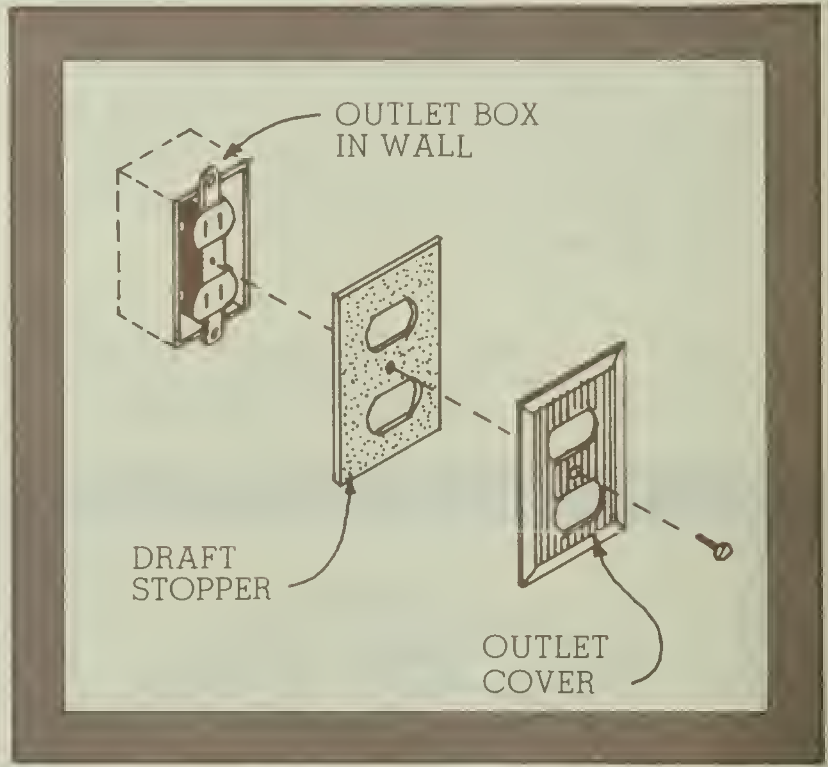
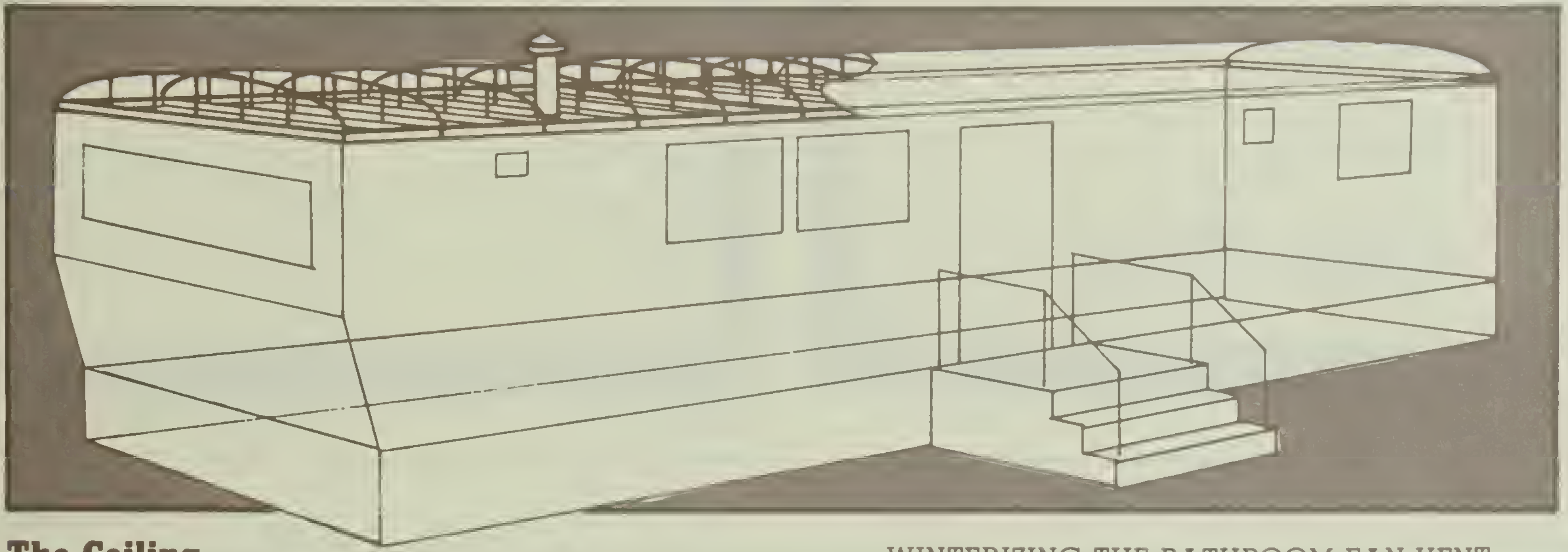


FIGURE 16
Draft stoppers placed behind outlet covers will conserve energy.



The Ceiling

The main trouble spots in the mobile home ceiling are the bathroom fan vent and the evaporation cooler inlet. Warm air rises and finds its way out the ceiling, losing you valuable heat and money.

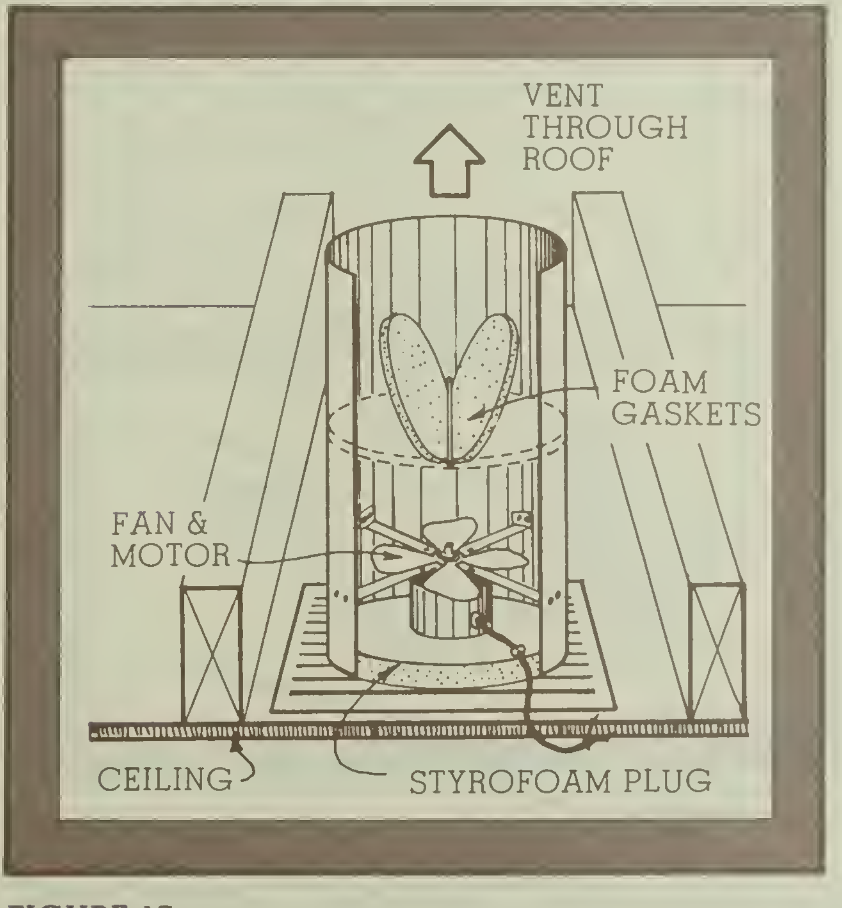


FIGURE 17

WINTERIZING THE BATHROOM FAN VENT

Heated air escapes through the fan vent when it is running and also when it is idle. There are several ways to overcome this problem. Remove the grille covering the fan blades and housing. If you can see daylight around the fan you may have to replace the two semi-circular gaskets that open and close when the fan is turned on and off. **(Figure 17)**

If you have trouble getting an airtight seal around the fan, you might consider plugging the fan opening for the winter with a piece of rigid insulating board. **(Figure 18)** Another option is to close the vent opening from the roof with a magnetic cover made especially for that purpose.

If you disconnect the fan for the winter you will have to be careful about excess moisture in the bathroom. Make sure to leave the bathroom door open after you shower to avoid a buildup of humid, moist air. REMEMBER TO REMOVE THE VENT PLUGS WHEN SPRING COMES. *NOTE: If you live in a moist climate you may encounter extreme air quality problems when covering up the fan vent. We recommend you don't close off the fan vent if moisture is a big problem in your area.*

WINTERIZING THE EVAPORATION COOLER INLET

The evaporation cooler inlet, generally located in the hallway of most mobile homes, is another hole through which heat escapes. Cut a square piece of rigid insulation to fit snugly in the opening and tape — with duct tape — or caulk the seam around the hole. **(Figure 19)**

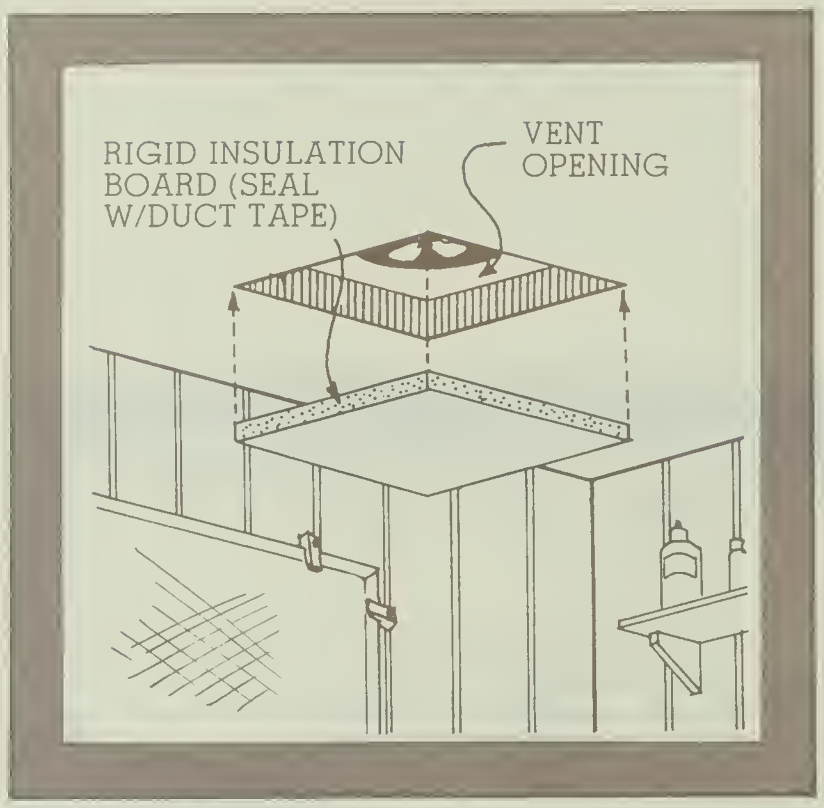


FIGURE 18
If you find that plugging this vent opening creates too much moisture in your bathroom, remove the rigid insulation.

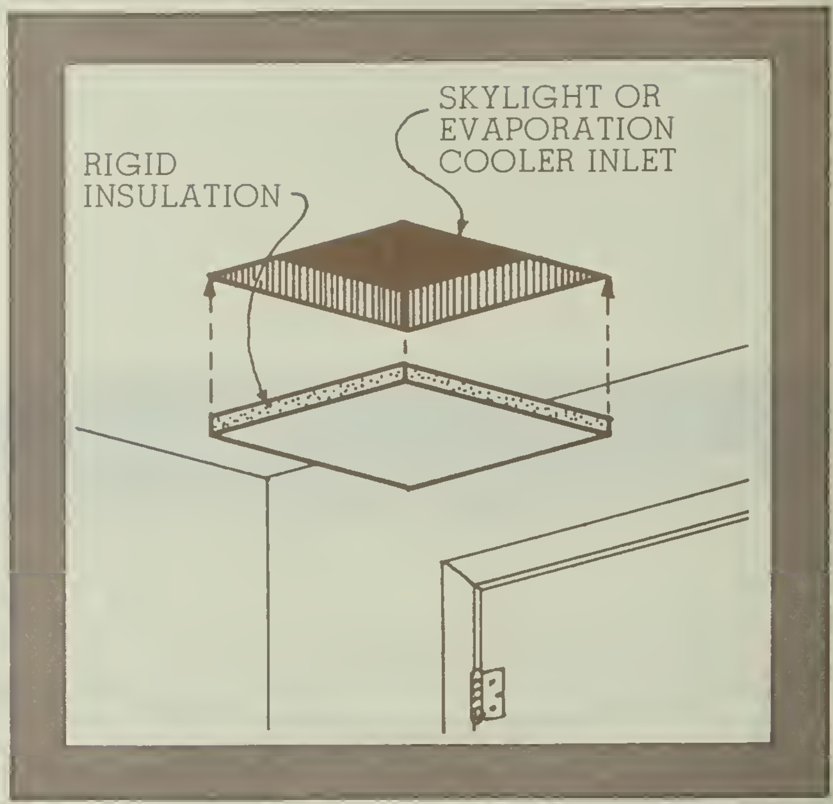


FIGURE 19
A lot of valuable heat rises up and out of the cooler inlet.

Moisture Problems

Moisture problems are common in mobile homes and they appear as watermarked ceilings, warped wall panels, and ice build-up on windows, walls and doors. Moisture can collect in walls and ceiling creating greater heat losses.

HOW MOISTURE BUILDS UP

Just as hot wants to move toward cold, wet wants to move toward dry. The air inside your mobile home is wetter than the outside air because you make coffee, perspire, shower with hot steamy water. Moisture travels through the skin of your mobile home from inside to outside as moist air escapes through the cracks. If the walls are cold, the moisture will condense into water or freeze into ice within the walls and ceiling. You can see this happening in the winter when warm moist air sneaks past the storm windows and water condenses and freezes on your primary windows. The same thing happens in wall and ceiling cavities where water condenses and freezes on the back side of siding and roofing or within the insulating material. Moisture reduces the effectiveness of insulating materials and will degrade them over time.

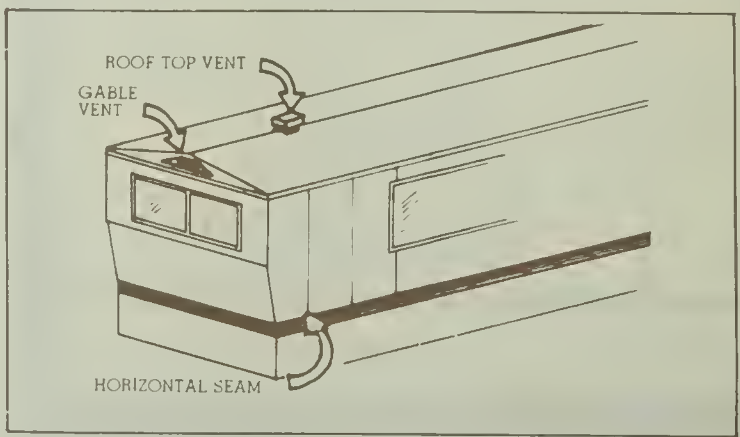
VAPOR BARRIERS

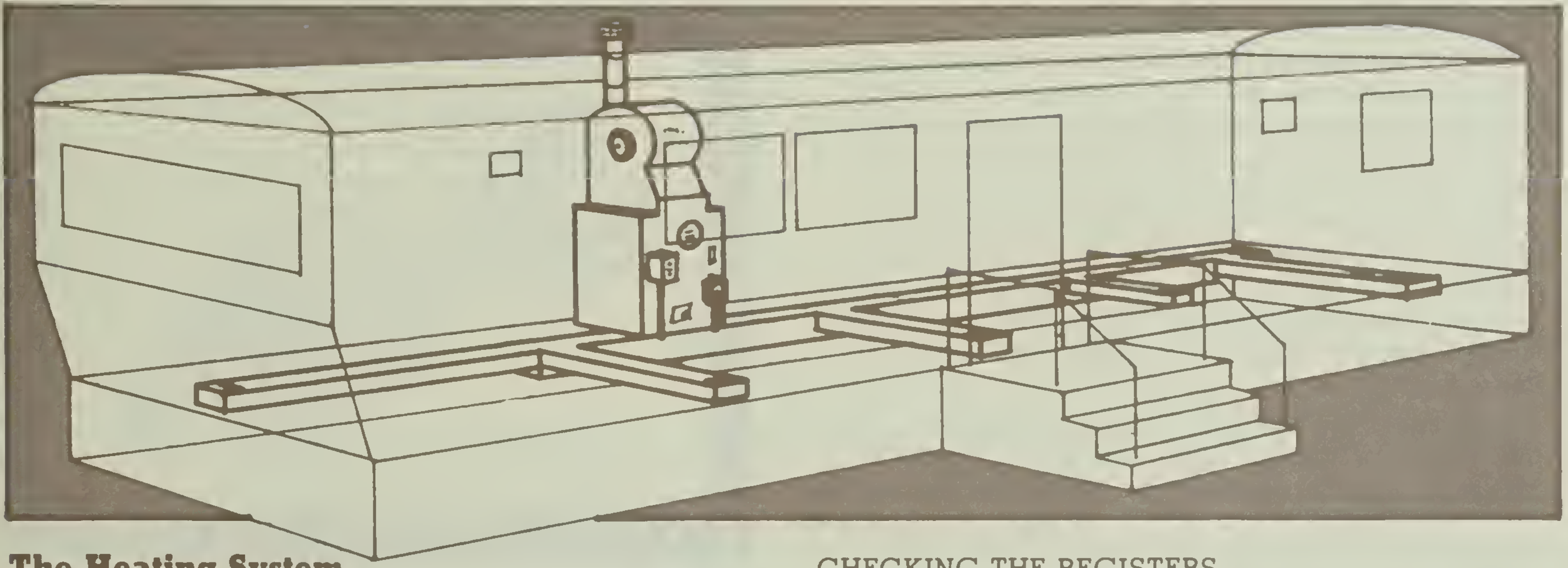
Modern mobile homes are wrapped in a layer of plastic film that stops most water vapor from entering the walls and ceilings. This layer of plastic film is installed directly behind the paneling and is called the vapor barrier. Even newer mobile homes with vapor barriers can trap moisture that infiltrates the building skin through electrical outlets and fixtures.

OVERCOMING MOISTURE PROBLEMS

Whether you have a vapor barrier in your mobile home or not, we suggest that you seal air leaks from the inside to reduce the amount of moisture that flows into the building skin. **CAUTION: Do not seal up horizontal joints between the siding and trim on the outside of a mobile home because these joints allow water to escape from the walls and they allow air to ventilate the walls and roof. (See drawing)** If you have serious moisture problems in your roof, standard roof and gable vents can help. The gable vents will let air into the attic space, and the mushroom cap roof vents will exhaust air out to keep the roof insulation dry and working effectively.

As you weatherize your mobile home, moisture problems will probably continue. On mild days, remove a few storms and open the windows and doors to circulate the air and reduce humidity. If condensation, water-spotting and frost persist, you may have to use a electric dehumidifier to reduce moisture.





The Heating System

There isn't any amount of weatherization that will compensate for a poorly maintained heating system. Often homeowners leave heating system maintenance to professionals, but that can be expensive and for that reason is sometimes neglected. If, for example, you notice that the furnace goes on regularly but you're not getting much heat, there are a number of heating system components that you need to check immediately.

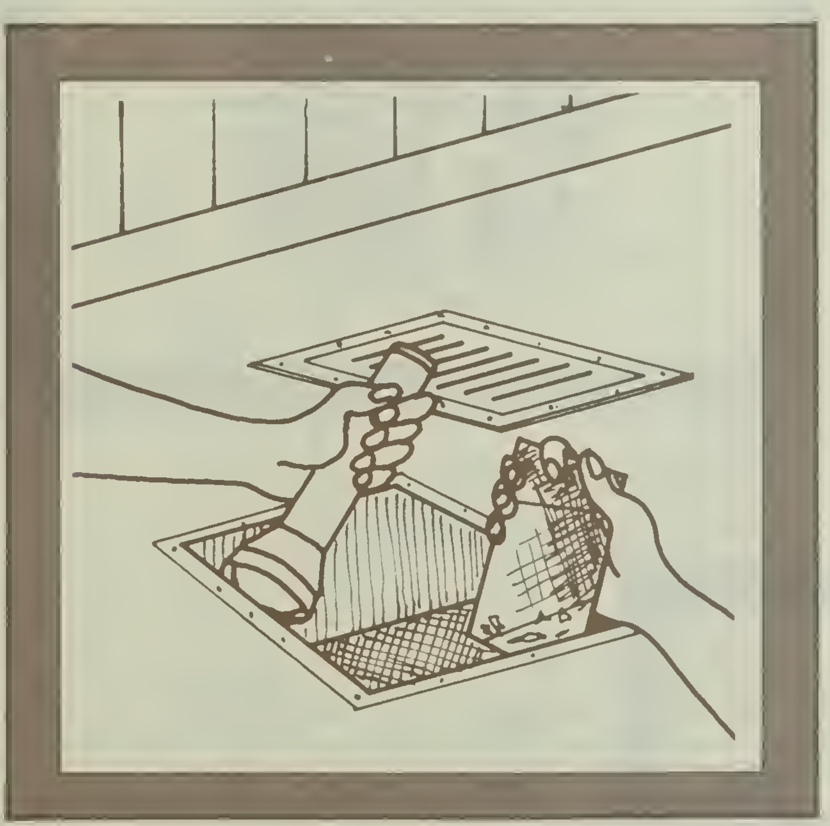


FIGURE 20
By using a flashlight and a mirror you should be able to spot any cracks in the ducts.

CHECKING THE REGISTERS

In mobile homes the air supply and return registers in the floor are sometimes walked on, bending the metal vent fins. When this happens the heat from your furnace cannot reach the room it ought to be heating. The fins can be straightened with needle nose pliers. You can buy sturdier floor registers that you can open and close and that will withstand more abuse, at your mobile home supplier.

Furniture ought to be moved away from all heating vents so it won't restrict air flow. Remember to close the heat register dampers and the doors in rooms you don't use regularly.

INSPECTING THE DUCTS

If your furnace goes on regularly, but you aren't getting much heat, check your heating ducts for leaks. This is easy to do if you have the belly boards off. If not, your only option is to take the heating register off and inspect the heating duct for dust and leaks using a flashlight and a mirror. **(Figure 20)** Vacuum the ducts if they are dirty. Check the inside of the ducts for cracks and leaks. Seal any leaks with duct tape or silicon caulking, which is available in most hardware stores.

INSTALLING A SCOOP

In many mobile homes the main heating duct runs under the floor the entire length of the mobile home. Oftentimes the heating registers in the end rooms are placed several feet from the end walls, meaning that there are several feet of unused duct beyond the registers. If your ductwork does not end at the register you should consider blocking off the unused part of the duct. **(Figure 21)**

MAINTAINING THE FURNACE

If your mobile home is heated with a furnace, there are several things you can do to increase its efficiency. Check the furnace filter; if it is dirty, replace it. *NOTE: Your furnace filter ought to be replaced twice a year. A dirty filter cheats you out of heat that you pay for.*

Dust and grease on the "squirrel cage" blower fan in your furnace prevents the fan from working at its best. In order to clean a dirty fan, first disconnect the blower unit, and remove the screws holding the unit in. **CAUTION: If you don't unplug the unit it could start up while you're working on it.**

After removing the blower unit, loosen the hub nut that holds the squirrel cage onto the motor shaft. To release the squirrel cage tap the shaft on the inside of the hub with a metal punch and a hammer, and pull the squirrel cage toward you. **(Figure 22)** Clean the squirrel cage with soap and hot water. While the squirrel cage is drying, remove the dust from the fan housing and motor using a toothbrush and a vacuum cleaner. **(Figure 23)**

If you would rather not work on your furnace and decide to have your furnace cleaned by a repairman, you might ask him about down-sizing your furnace. Some furnaces provide more heat than is necessary for a particular climate. By putting smaller gas or oil jets in the furnace or by disconnecting one or two of the electrical heating elements you can save energy. A professional heating contractor should be able to tell you if this is an option.

Also ask your heating expert to look at the furnace plenum. The plenum is a large box that distributes air from the fan to the main ducts. The plenum on some mobile homes is much larger than necessary causing air turbulence in the plenum and increasing resistance to air flow. Blocking off the unused part of the plenum reduces turbulence and improves air flow. **CAUTION: Make sure that in tightening up your home you haven't cut off combustion air to your gas furnace. Combustion air for your furnace comes through an opening in the crawl space or on the roof. Make sure that these openings remain unobstructed.**

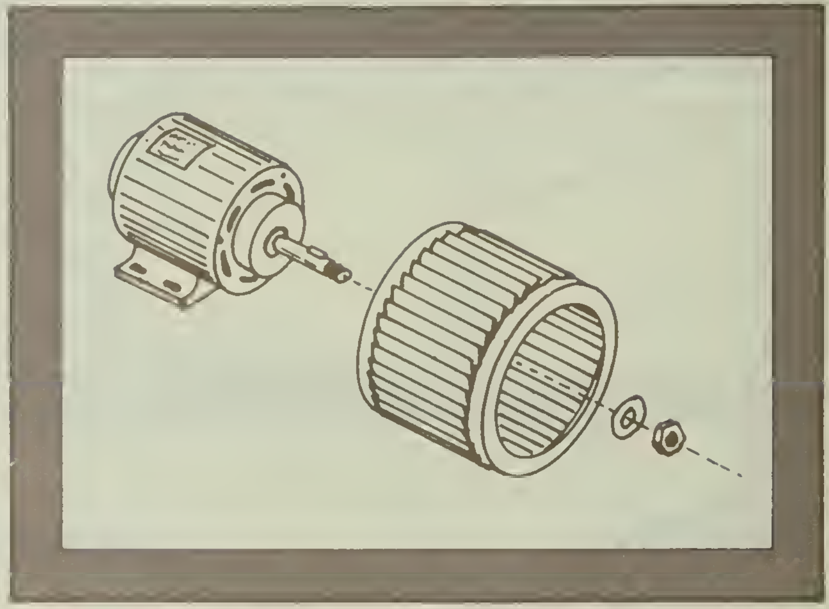


FIGURE 22:
Remove the hub nut and pull the squirrel cage toward you to release it from the motor shaft.

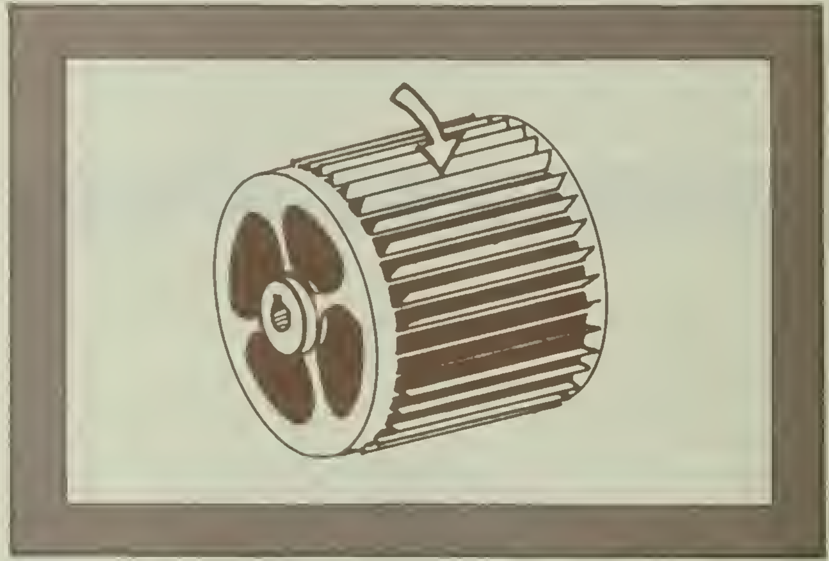


FIGURE 23:
Use a toothbrush to clean dust and dirt off the fins of the fan housing.

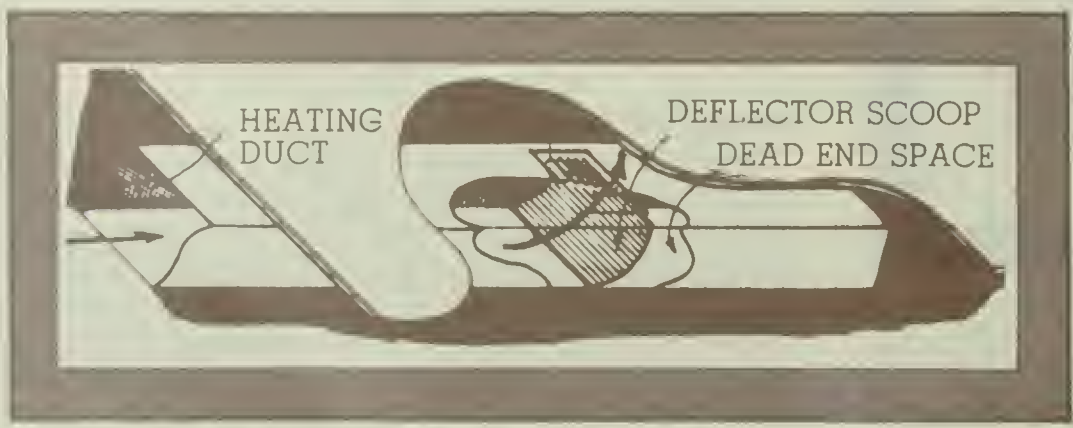


FIGURE 21
A sheetmetal scoop will force heat back up into the room rather than heating unused duct space.

Is Your Thermostat Working Properly?

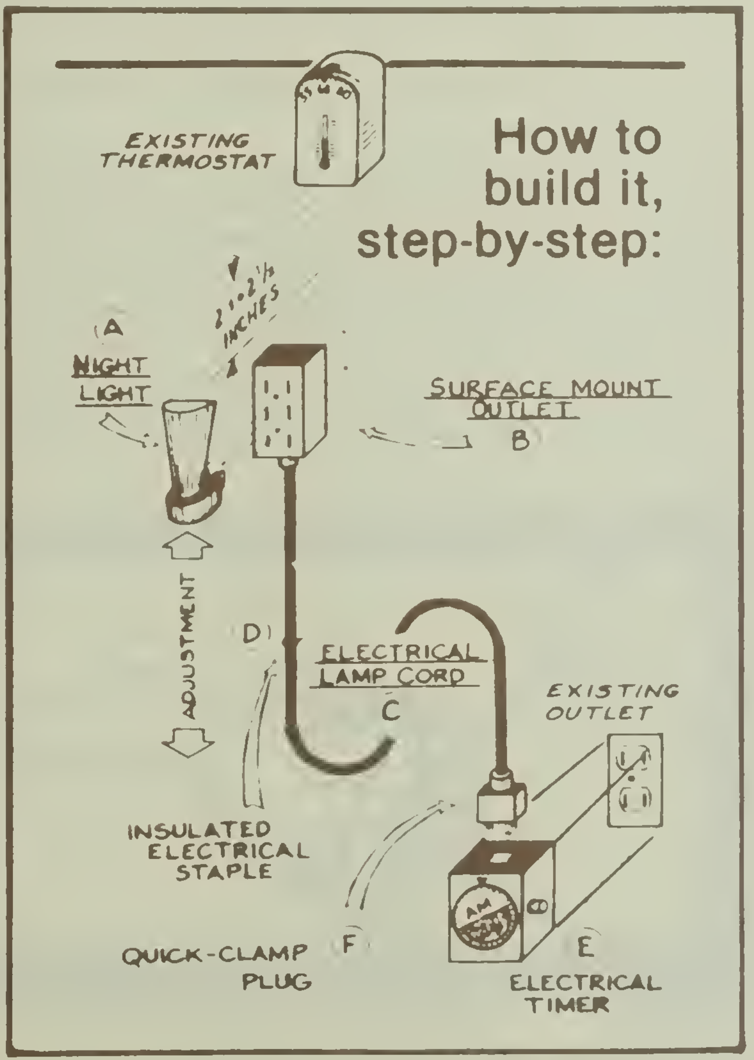
If your thermostat is located near a window or a heat source — a light or television — it may be fooled by the temperatures nearby and might not be controlling your furnace properly. Using a thermometer, check the room temperature at different times of the day and compare it to the setting on your thermostat. Adjust your thermostat to compensate for any differences that you find. Consult a heating expert if necessary. An improperly placed thermostat or one that doesn't work can waste a lot of energy.

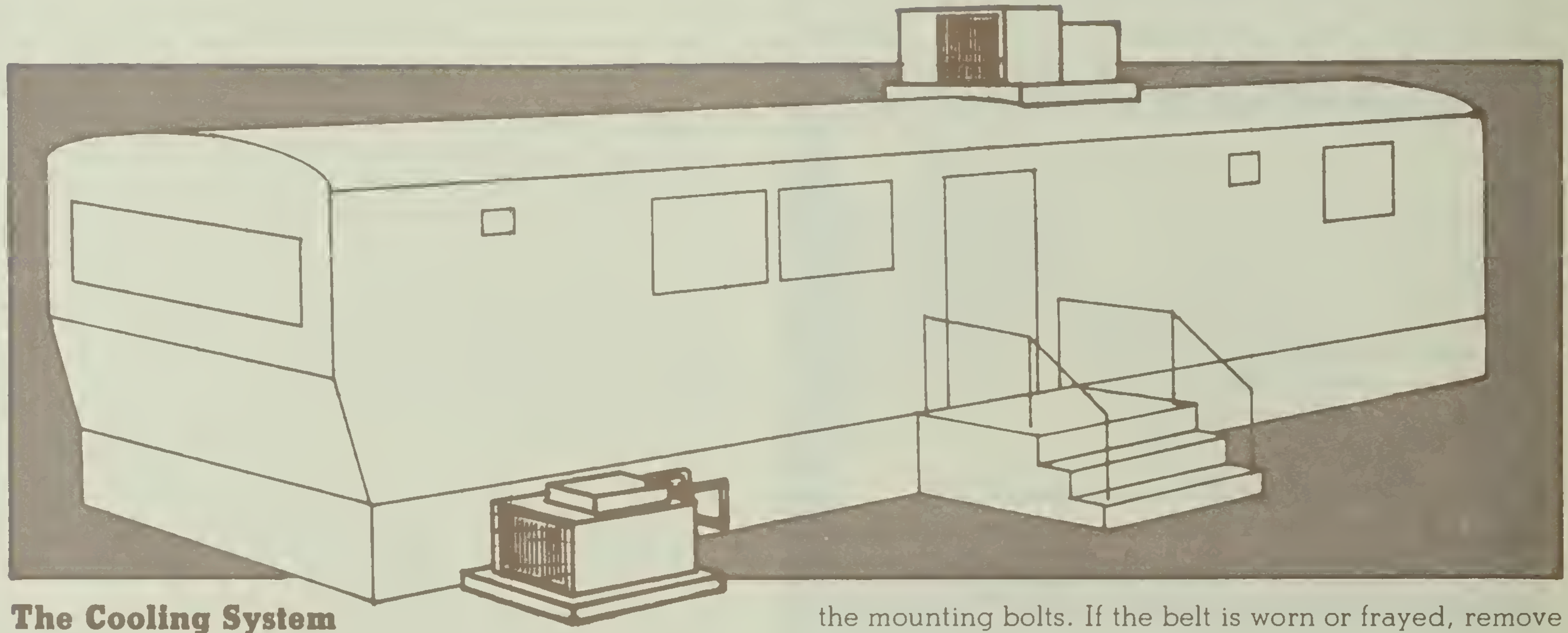
BUYING A CLOCK THERMOSTAT

You can buy a thermostat with a built-in clock that automatically reduces your thermostat setting from 65 to 55 degrees shortly before you go to bed and returns the setting to 65 degrees before you wake up. These clock thermostats can cut your heating bills by 10 percent. *NOTE: You don't need to buy a clock thermostat if you are already lowering your thermostat at night and raising it in the morning.*

BUILDING A CLOCK THERMOSTAT

You can build a simple clock thermostat using your present thermostat, an electric timer and a night light for about $10. The timer turns the night light on and off at prescribed times: the heat from the light makes the thermostat think that the room is warmer than it actually is, keeping the furnace from going on and saving you money. The following drawing shows you how to set up your clock thermostat.





The Cooling System

Cooling systems — air conditioners and swamp coolers — operate most efficiently when the filters are kept clean and the compressors, pumps and motors are lubricated and maintained. Cooling systems aren't any harder to maintain than heating systems and a minimum amount of maintenance will keep them operating efficiently.

REPLACING AND CLEANING THE FILTERS

Both air conditioners and swamp coolers use filters to keep the circulating air clean. When these filters get dirty the fan has trouble moving the air and cooling it. The air conditioner filter on a room air conditioner is usually located behind the grille where the cool air comes out. The filter, often a sheet of porous foam rubber, can be cleaned by washing it in warm water. Clean or replace the filter once a month if you use the air conditioner every day. Replace the filter at least twice a year. In central air conditioning systems the cool air filter is often the same as the furnace filter and is located near the blower or in the return-air register.

With a swamp cooler, the porous aspen pads — located on the sides of the cooler box — ought to be changed once or twice a year. Some swamp coolers have fibrous filters in front of or behind the aspen pads. Clean or replace these filters once or twice a year.

CHECKING THE FAN OR COMPRESSOR BELT

Periodically check the tension of the fan or compressor belt on your cooling unit. Some manufacturers recommend that the belt not have any more than ¾ inch of slack in it when you press down on it. Check with the manufacturer for the recommended amount of slack for your particular belt. If it is loose, tighten it by first loosening the mounting bolts on the electric motor. Then pull the motor down until the belt is tight. Then retighten the mounting bolts. If the belt is worn or frayed, remove it and replace it.

LUBRICATING THE PUMPS, MOTORS AND FANS

The water pumps in swamp coolers ordinarily don't survive more than several years of hard use. If the bearings are accessible, oil them. In order to test the pump, turn the cooler on and look to see if the pump is supplying water to the aspen pads; if not, you will need to replace the pump.

Place a couple of drops of lightweight machine oil into the hole marked "oil" near the shafts of the electric motors, compressors and fans. **(Figure 24)** Dirt on the air conditioner condenser coils or inside your cooling unit will affect its performance. Special cooling fin combs are available through heating and air-conditioning contractors to clean cooling fins. Keep your cooling unit clean!

Cover your air conditioner or swamp cooler with plastic or canvas during the winter when you are not using it.

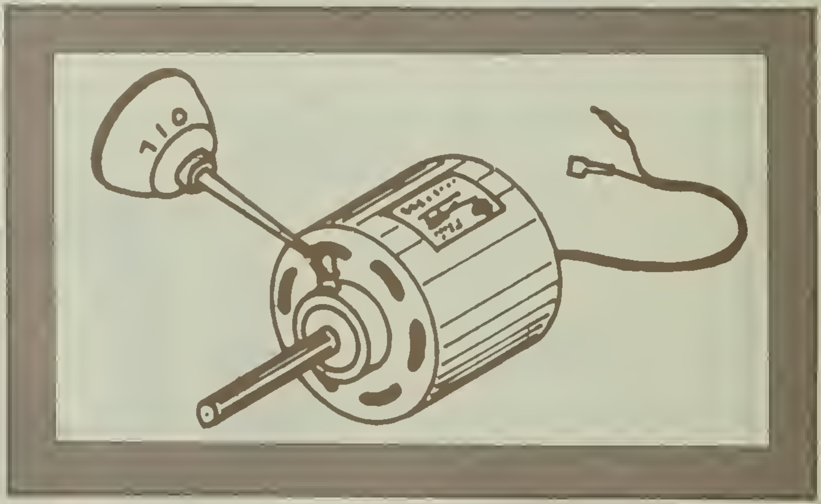
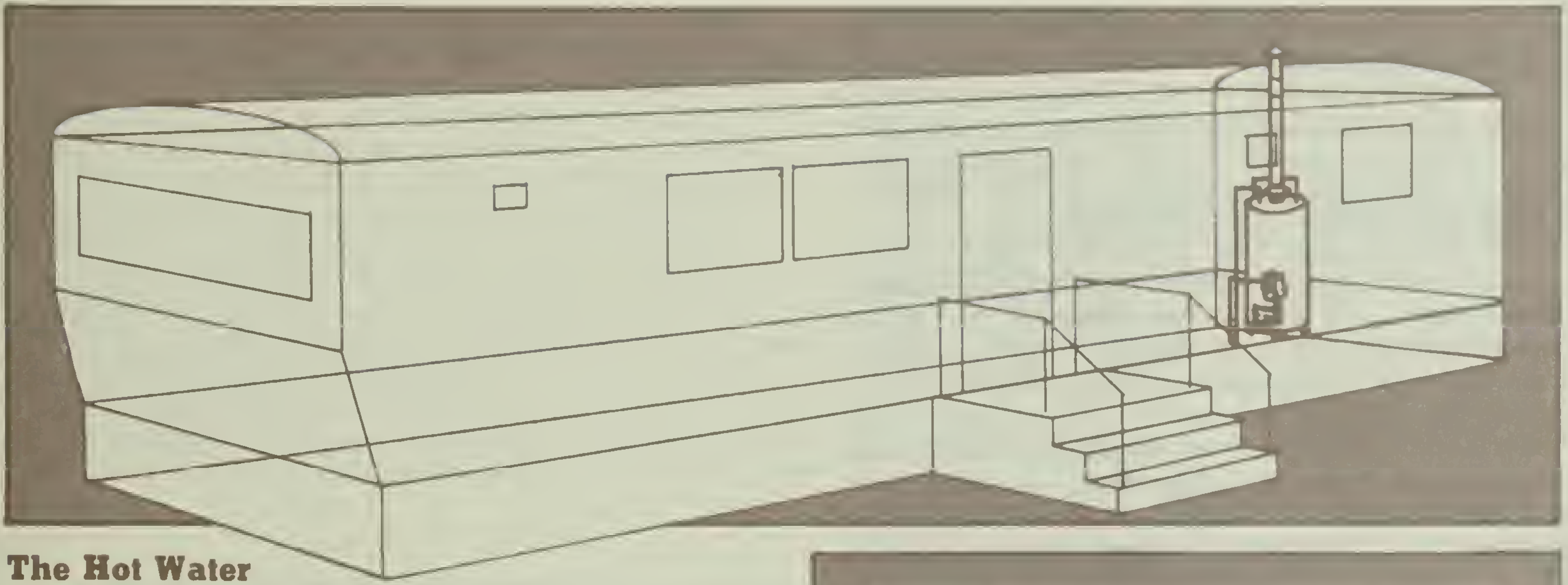


FIGURE 24
A well lubricated motor will make your cooling unit work much more efficiently.



The Hot Water Heater

The hot water heater is the second largest energy user in most households. Energy and money can be saved by insulating your hot water heater and pipes in order to prevent the loss of valuable heat.

LOWERING THE TEMPERATURE SETTING

Before insulating your hot water tank, reset the temperature setting on your tank. If you have a dishwasher you will need 140 degree F. water. Set the dial at the lower end of the medium range. For normal use without a dishwasher 120 degrees is adequate. Try setting the dial lower. After insulating the tank you may be able to lower the setting even further. **(Figure 25)**

FLUSHING THE TANK

Sediment collects in the bottom of your water heater, and covers the heating elements, wasting energy. Open the drain spigot at the bottom of your water heater and drain several gallons of water from the tank every couple of months. This will help to flush the sediment out of your tank and make your water heater perform more efficiently.

If your electric hot water heater is not heating water properly, you may have corroded heating elements.

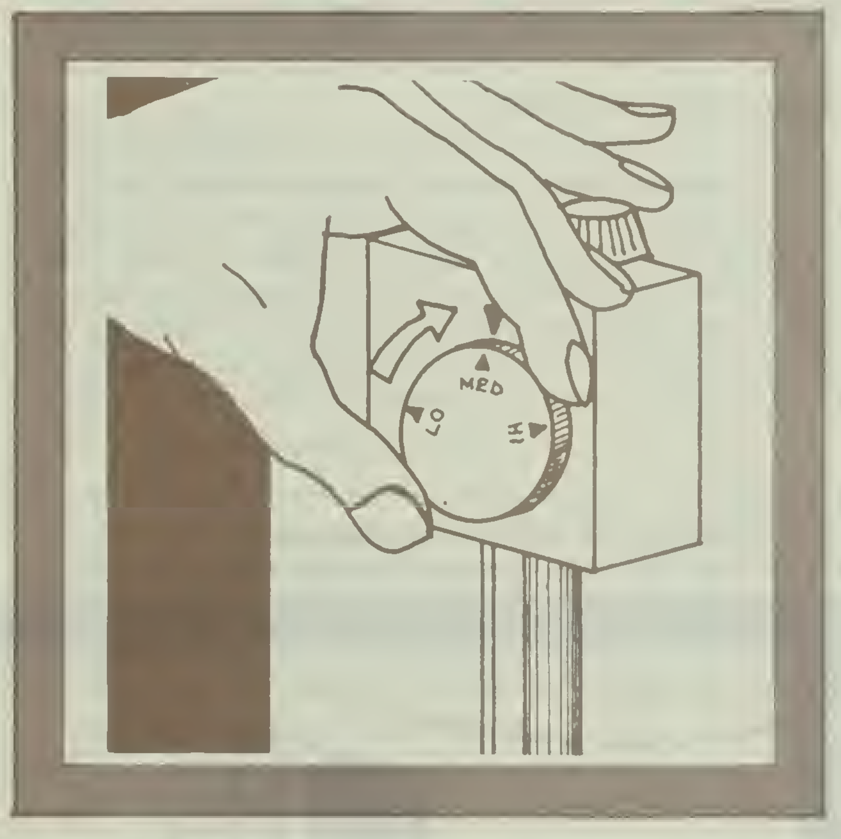


FIGURE 25
Lowering the temperature on your hot water heater will save you energy and money.

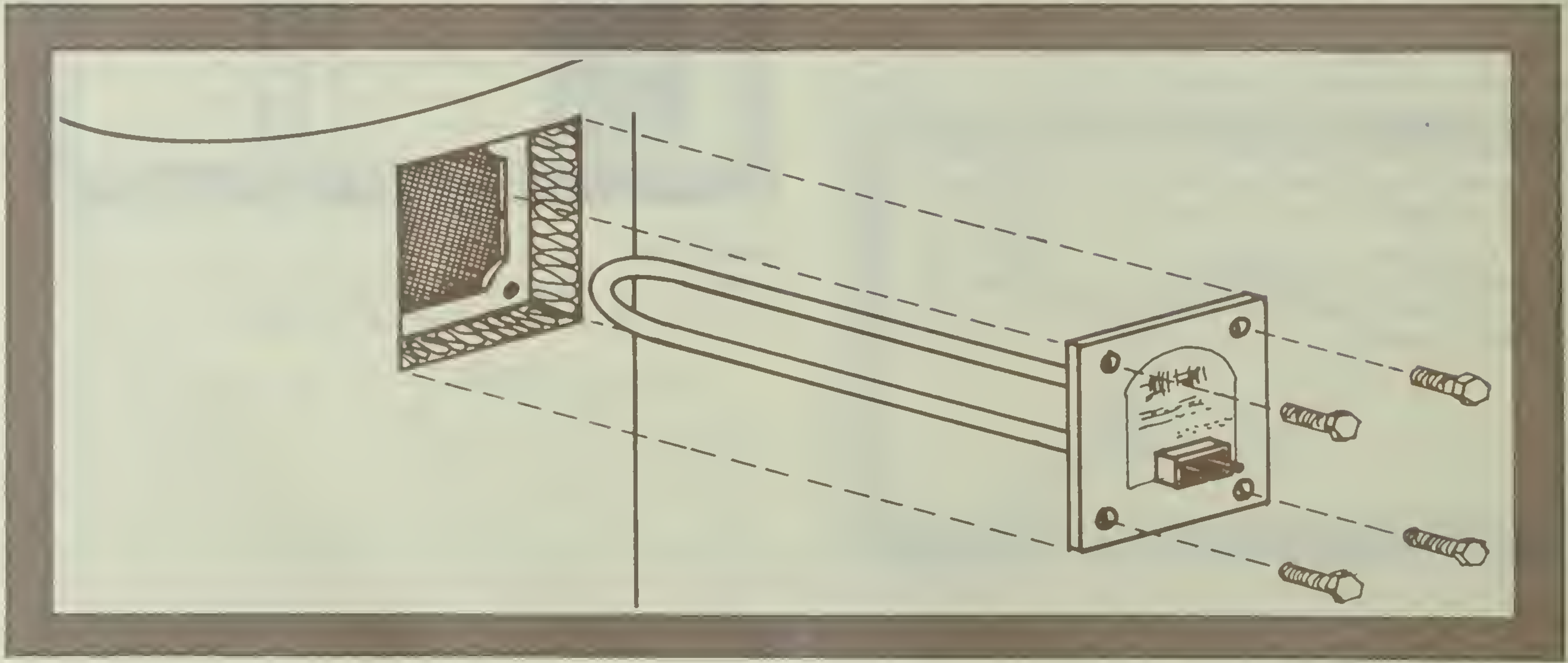
This is a common problem in areas where the water is hard — contains large amounts of corrosive minerals. If that is your case, you may want to install a water softener to remove the corrosive minerals from the water. Corroded heating elements can be replaced but first: **SWITCH OFF THE 220 VOLT CIRCUIT BREAKER BEFORE REMOVING THE ELEMENTS!**

Then drain the tank. Next remove the plate on the top and bottom of the water heater that holds the elements in place. **(Figure 26)** Remove the elements. If they are corroded you can either try cleaning them with vinegar or muriatic acid or replace them. It is probably safer to replace the elements because you might damage the elements while cleaning them, without realizing it. Also the seal on the element plate might not reseal after cleaning the elements. NOTE: *Consult a local plumbing supplier about replacement elements before removing them.*

INSULATING THE TANK

There are a number of different ways to insulate a gas- or oil-fired hot water heater. Kits are available at some hardware stores or building suppliers, but they are often expensive and not always effective. NCAT has developed a safe, simple and inexpensive method using coat hangers and fiberglass insulation. For less than $4 and an hour's time you can insulate your hot water tank. You can order a booklet describing this method from NCAT for $.75.

FIGURE 26
Do not remove the old elements until you are certain that replacements are available.



A CONSERVATION CHECKLIST

The advice presented in this booklet is not meant to overwhelm you or your family. Its sole intention is to try and save you energy and money. Set up a weatherization schedule that you feel comfortable with — don't try and do everything during a single Saturday. You can gain moral support by discussing these energy-saving solutions with a neighbor or your mobile home association. You may also be able to save money on weatherization materials by purchasing them in bulk through your association or a cooperative neighborhood effort. For example, it will be much cheaper for three or four households to share the cost of a larger amount of insulation or caulking from a wholesaler.

By following this simple checklist you can cut your energy costs by at least 10 percent without spending any money.

DURING THE HEATING SEASON . . .

* Ask local utility to relight your furnace pilot light,
* Open outside doors only when necessary,
* Close your heating register dampers in rooms that are not used often,
* Open draperies and shades on the south during the day and close all of them at night,
* Lower thermostat to 65 degrees during the day and to 55 degrees at night,
* Wear warm clothing,
* Operate ventilating fans as little as necessary,
* Close dampers on wood stoves and fireplaces when not in use.

DURING THE COOLING SEASON . . .

* Ask local utility to turn off pilot light at end of heating season,
* Open outside doors as seldom as possible,
* Close draperies and shades during the day and open them at night,
* Turn off cooling unit and open windows at night when temperatures go down,
* Use small fans to circulate air inside,
* Close off rooms you don't use,
* Use heat-producing appliances as little as possible during the heat of the day.

WHEN COOKING . . .

* Keep range burners, burner heat reflectors and oven clean,
* Select a pot or pan that fits the burner you are cooking on,
* Cook with low or medium heat and use lids,
* Use a timer when cooking so you don't have to remove lids or open oven door,
* Use electric pans or ovens for small meals,
* Use pressure cookers or microwave ovens if you have them.

IN THE LAUNDRY . . .

* Fill dryers, don't overload them, and keep the lint screen clean,
* Fill washers, don't overload them, and wash with warm or cold water.

HOT WATER . . .

* Don't let the hot water run in the sink, fill the sink to wash,
* Leave hot water in the sink and tub during the winter until it cools,
* Fill the dishwasher before starting it, but don't overload it.

YOUR REFRIGERATOR . . .

* Make sure the door seals tight,
* Be sure to get out what you need before shutting the door,
* Dust the condenser coils on the back or bottom of the box once a year,
* Defrost the freezer when ¼ inch of frost accumulates on the inside.

Remember that the success of your weatherization efforts depends on your household habits. You cannot expect to achieve maximum energy savings if your family leaves doors and windows open or allows the hot water to run without using it. By completing the weatherization tasks outlined in this booklet you will become more aware of how you and your family use energy and how you can save money by conserving energy.

RESOURCES

BOOKS

Wm. Langdon, **Movable Insulation** (Emmaus, PA.: Rodale Press, 1980).

Wm. Shurcliff, **Thermal Shutters and Shades** (Andover, MA.: Brickhouse, 1980).

BOOKLETS

"Mobile Home Reinsulation Application Manual," Owens Corning Fiberglass Corp.: Fiberglass Tower, Toledo, OH. 43659.

"The New Mexico Mobile Homeowner's Guide," New Mexico Energy and Minerals Dept., Energy Extension Service: Box 2770, Santa Fe, N.M. 87503.

MAGAZINES

"Making the Most of a Mobile Home," **New Shelter** (Emmaus, PA.: Rodale Pres, Sept. 1980).

WHOLESALE SUPPLIERS OF WEATHERIZATION PRODUCTS

(They do not deal directly with consumers but they will supply you with the name of a retailer in your area.)

C.R. Laurence Co.
Box 21345
Los Angeles, CA 90021

Distributor of glazing supplies, window parts, insider storm windows, jalousie window weatherstripping and much more. Distributes through glass retailers.

Energy Control Products
3-M Co.
St. Paul, MN 55144

Manufacturers of Scotchtint™ window insulation films and Flexigard™ acrylic film.

Energy Defender Corp.
Box 2
Mahopac, NY 10541

Manufacturers of interior storm windows.

K-C Designs
Box 2734
2120 S. Rustin
Sioux City, Iowa 51106

Distributor of high quality weatherization products including: weatherstripping, caulking, venting devices and much more.

Magneticseal Inc.
130 S. Elkhart Ave.
Box 547
Elkhart, Indiana

Manufacturers of magnetic seal, interior storm windows.

Monsanto Corp.
800 N. Lindbergh Blvd.
St. Louis, MO 63166

Manufacturers of ¼ inch Fome-Cor™ styrofoam sheathing board used as insulation and an air infiltration barrier.

Sentinel Energy Saving Products
Hyannis, MA 02601

Distributes a wide variety of energy-saving products for homeowners.

Shepherd Products Co.
Box 427
Kalamazoo, MI 49005

Distributor for DuPont Tyvek™ air infiltration barrier.

Thermco Insulation Products and Systems
Highway 34 West
Mt. Pleasant, Iowa 52641

Distributors of an insulated roof system for mobile homes.

Thermo-Ann Industries
3415 West Whitton
Phoenix, Arizona 85017

Manufacturers of an insulated roof system for mobile homes.

Viking Energy Systems
275 Circuit St.
Hanover, MA 02339

Manufacturers of Magnetite™ interior storm window.

Virginia Iron and Metal Co.
Box 8229
Richmond, VA 23226

Manufacturers of Vimco Solar Shield™ shade screen for windows.

Vulcan Metal Products Inc.
No. 1 Irondale Industrial Park
Box 6788
Birmingham, Alabama 35210

Manufacturers of Vulco™ interior storm windows.